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OBSTRUCTION OF THE URETER THE MOST FREQUENT PREDISPOSING CAUSE OF THE LOCALIZATION OF BACTERIA IN THE PELVIS OF THE KIDNEY.

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The purpose of this paper is to emphasize the facts that bacteria will not usually remain in the kidney long enough to produce damage, unless there is some obstruction in the drainage tract, and that often bacteria may be present in the ureteral urine without producing any marked clinical symptoms.

It is only recently that much interest has been shown in the subject of ureteral obstruction as a frequent cause of indefinite abdominal symptoms, and that much activity has developed in the use of the cystoscope for diagnosis and treatment. One has only to review the highly pleasing results obtained by such treatment after other measures have failed, to arrive at the conclusion that such interest, and such activity, are highly laudable and should be stimulated. Many patients who have been treated previously for months, and even years, for suspected disease of the appendix, of pelvic, and of other abdominal organs, are entirely relieved by local treatment after the cystoscope has revealed the true condition.

Obstructions of the ureter may be intrinsic or extrinsic in origin. They may be partial or complete, and congenital or acquired. The latter are the more frequent by far, and may be due to localized inflammation from infection, trauma of calculi, kidney ptosis, etc., with resultant periureteritis, and later fibrosis of adjacent tissues. In this connection I may mention one case that developed stricture after roentgen ray treatment for fibroid uterus, and in which strictures were actually present in the lower end of both ureters. Whether these strictures were actually caused by the ray is conjectural.

Recently, attention has been drawn to the fact that kidney inflammations are quite common in childhood. Usually the symptoms are more acute than in the adult, being accompanied by high fever, prostration, and nervous irritability, and generally associated with acute intestinal disturbance. Stricture of the inflammatory fibrotic type might thus be produced early in life, and cause recurrent definite attacks, later on being transformed into active disease processes by simple bacteriuria, which in itself would be harmless. On the other hand, in the absence of bacteria, such a stricture, if slight, may be present all through life, and produce no symptoms.

Inflammation without infection does occur in the pelvis of the kidney. Generally these cases are associated with some obstruction in the drainage tract. The centrifugalized urine catheterized from the ureter of such a case, contains a great number of cells from the pelvis and ureter and red blood cells, and, at the same time, the culture will be sterile.

In our opinion, this is the pre-existing stage of lowered resistance, and precedes true pyelitis. Is it not to be expected that such interference with drainage will result in a lowered resistance of the kidney tissue, and that the ureteritis that exists above a constriction, just as in the male urethra, will provide a fertile field for the localization and growth of organisms? In many of our low ureteral stricture cases this process has been well illustrated. Unless the above-described conditions of lowered resistance are present, bacteria may easily pass through the entire urinary tract without producing any pathological changes.

In view of the above, it is very important that one should be able to determine the presence of obstruction early, before a possible bacteriuria renders the case more serious and the treatment more difficult. Unfortunately, at this stage, the symptoms are not often sufficiently well marked in the milder cases to indicate the location of the trouble. Backache and discomfort in the lumbar region and lower quadrants of the abdomen are often present, but a greater number of patients are not cognizant of any existing trouble. Many cases go along for years before symptoms develop, and then a condition is often present which renders the removal of the kidney necessary.

The admitted difficulty of early diagnosis of mild, uncomplicated obstruction from symptoms alone, naturally impelled us to approach the matter from some other angle. We have shown that the real danger in these cases is from the possible development of a bacteriuria. This condition is easily dis-

Case.	Operation.	Bladder Culture Before Operation.	Bladder Culture After Operation.	Postoperative Cystoscopy with Catheterization of Ureters and Culture Right Kidney.	Left Kidney.	Pyelogram.	Diagnosis and Result.
1.	Perineorrhaphy; repair of left tube; retroperitoneal shortening of round ligaments; appendicectomy.	Sterile.	B. Coli.	Sterile.	B. Coli	Stricture of ureter and angulation.	(Illustration) Pyelitis of left kidney, stricture and angulation at upper portion of ureter, dilatation of lower ureter, partial atresia of left ureteral meatus, duration 6 months, improved, but still present.
2.	Supravaginal hysterectomy (fibroid); appendicectomy.	Sterile.	B. Coli.	Sterile.	B. Coli	Stricture of ureter.	Pyelitis of left kidney, stricture of lower ureter, duration 3 months, improved, sterile culture.
3.	Appendicectomy; retroperitoneal shortening of round ligaments; resection of right ovary.	Sterile.	B. Coli.	B. Coli	Sterile.	Stricture of ureter.	Pyelitis of right kidney, stricture at upper third of ureter, duration 14 months, improved, sterile culture.
4.	Cholecystectomy; appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Ptosis of kidney, tortuous ureter and kinks.	(Illustration) Pyelitis and ptosis of right kidney, tortuous ureter with kinks and angulation, duration 4 months, still present.
5.	Unruptured tubal pregnancy; appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Stricture of ureter.	Pyelitis of right kidney, stricture of lower ureter, duration 2 months, sterile culture.
6.	Dissection of sigmoid and left broad ligament and reconstruction of the latter; appendicectomy; retroperitoneal shortening of round ligaments.	Sterile.	B. Coli.	Sterile.	B. Coli	Stricture of ureter.	(Illustration) Pyelitis of left kidney at superior calyx, stricture at ureteropelvic junction, narrowing of upper third of ureter, duration 18 months, still present.
7.	Bilateral salpingectomy for pyosalpingitis; appendicectomy.	Sterile.	B. Coli.	Sterile.	B. Coli	Ptosis of kidney and kinks of ureter.	Pyelitis and ptosis of left kidney, kinks of ureter, duration 2 years, improved, sterile culture.
8.	Supravaginal hysterectomy (fibroid); appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Not taken.	Pyelitis of right kidney, stricture of lower part of ureter, duration 11 months, culture b coli still present, refused treatment.
9.	Releasing adhesions of omentum; appendicectomy.	Sterile.	B. Coli.	Sterile.	B. Coli	Stricture and angulation of ureter.	(Illustration) Pyelitis of left kidney, stricture and angulation at ureteropelvic junction, duration 6 months, b coli still present.
10.	Curettage; retroperitoneal shortening of round ligaments; appendicectomy.	Sterile.	B. Coli.	B Coli (Acute on 12th day)	Sterile.	Stricture and kink of ureter.	Pyelitis of right kidney, stricture and kink of ureter, duration one year with return of symptoms and positive b. coli culture.
11.	Appendicectomy (acute appendicitis.)	Sterile.	B. Coli.	B. Coli	Sterile.	Stricture and angulation of ureter.	(Illustration) Pyelitis of right kidney, angulation, stricture and narrowing of upper third of ureter, dilatation of pelvis of kidney, duration 10 months, improved, culture sterile.
12.	Incision of fibrotic bands and releasing fixation of duodenum which caused incompetency (obliteration of both ovaries with atrophy of uterus following intensive *x*-ray treatments for hemorrhage from uterus.)	Sterile.	B. Coli	B. Coli.	B. Coli.	Stricture of both ureters at lower end.	Pyelitis, bilateral, stricture at lower end of both ureters, duration 2 years, still present.
13.	Reconstruction of left broad ligament and sigmoid; retroperitoneal shortening of round ligaments; appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Constriction of ureter.	(Illustration) Pyelitis of right kidney, narrowing of upper third of ureter due to congestive ureteritis, duration 2 years, improved, culture sterile.

Case.	Operation.	Bladder Culture Before Operation.	Bladder Culture After Operation.	Postoperative Cystoscopy with Catheterization of Ureters and Culture Right Kidney.	Left Kidney.	Pyleogram.	Diagnosis and Result.
14.	Appendicectomy (acute appendicitis).	Sterile.	B. Coli.	Sterile.	B. Coli	Ptosis of kidney and kink of ureter.	Pyelitis and ptosis of left kidney, kink of ureter, duration 14 months, still present.
15.	Supravaginal hysterectomy (fibroid); appendicectomy.	Sterile.	B. Coli.	Sterile.	B. Coli	Stricture of ureter.	Pyelitis of left kidney, stricture at lower end of ureter, duration 7 months, improved, sterile culture.
16.	Bilateral salpingo-oophorectomy for pyosalpingitis; appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Ptosis of kidney and kink of ureter.	(Illustration) Pyelonephritis of right side, angulation of upper third of ureter, tortuous ureter and angulation and dilatation lower third, duration 2 years, still present.
17.	Resection of right ovary; retroperitoneal shortening of round ligaments; appendicectomy.	Sterile.	B. Coli.	B. Coli	Sterile.	Constriction of upper third of ureter.	(Illustration) Pyelitis of right kidney, constriction of upper third of ureter with ureteritis, duration 16 months, improved, but still present.

Right kidney was attacked in 9 cases.
Left kidney was attacked in 7 cases.
Both kidneys were attacked in 1 case.
The ages of patients were 57, 47, 46, 46, 44, 42, 40, 38, 38, 37, 36, 35, 32, 30, 28, 27, 27.

covered by urine culture. Therefore we have added this measure to our routine examination of all patients, and it has shown some interesting facts which will be stated a little further on. Whenever a positive culture persists, and the patient permits, a cystoscopy and ureteral catheterization is performed.

In investigating bacteria in the urine, it is well to attempt to discover their source. Different theories have been advanced with regard to the manner in which they reach the kidney, and though ably supported, are without positive proof. The manner in which bacteria enter the blood stream, as through traumatized tissues, infected tonsils and teeth, etc., as well as their property of selecting certain favorite places for localization, have been too amply and ably discussed elsewhere to review here. I desire only to state that investigations carried on with several colleagues have led us to believe that bacteria may be carried to the kidney by the blood stream, and may also migrate directly through the tissues from a neighboring inflammatory focus. The latter is more frequent on the right side from an infection in the bowel, which lies in close apposition. We believe also, that certain bacteria, as the colon bacillus, have a predilection for the urinary tract, as is indicated in the cases reported in this paper.

Kretschmer reports a study of 200 cases of pyelitis consisting of 61% females, and 39% males. Colon bacilli were present in 132 cases, staphylococci in 28, streptococci in 1, both colon bacilli and staphylococci in 10, and both staphylococci and streptococci in 1. Both kidneys were infected in 99 cases, the right alone in 32, and the left alone in 17.

In the past two years, we have been studying the urine by culture, before and after operations where the appendix was removed. At first, cultures were made only after operation. A number of cases showed the presence of the colon bacillus or one of the colon group. This inspired further study, and cultures were made of the catheterized bladder urine both before and after operation. Thirty-four per cent. of the cases that were sterile before the appendix was removed produced cultures of colon bacillus within a few days afterward. Cultures were made from other patients not operated on, as controls; repeated catheterization in the control cases did not produce positive cultures.

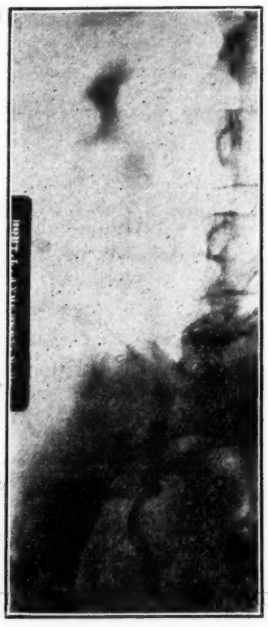
The result of these investigations indicated that the organism reached the kidney pelvis through the blood stream, following trauma produced by appendicectomy. Different methods of treating the appendix stump were noted, with no appreciable difference in the result.

We are now investigating these facts in operations on the colon, rectum, and gall-bladder. The results will be reported later. It is suggested here that such an investigation before and after obstetrical delivery might prove profitable.

In the cases were culture remained positive from three to six weeks after operation, catheterization of both ureters and collection of urines for culture was done to ascertain whether or not both kidneys were

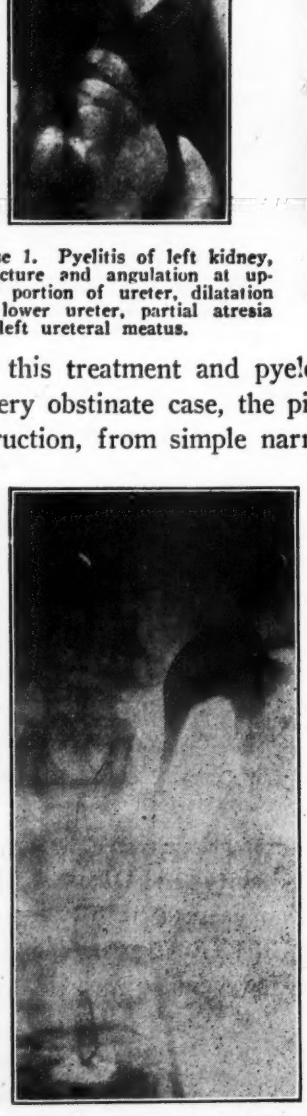
infected. In the majority, only the right one was involved. Irrigations of mercurochrome and argyrol were used in treatment, and in a few cases a cure was produced. The majority, however, did not yield

Case 1. Pyelitis of left kidney, stricture and angulation at upper portion of ureter, dilatation of lower ureter, partial atresia of left ureteral meatus.



Case 3. Pyelitis of right kidney, stricture at upper third of ureter.

to this treatment and pyelograms were made. In every obstinate case, the pictures showed some obstruction, from simple narrowing of the lumen, to



Case 6. Pyelitis of left kidney, at superior calyx, stricture at uretero-pelvic junction, narrowing of upper third of ureter.

Case 9. Pyelitis of left kidney, stricture and angulation at uretero-pelvic junction.

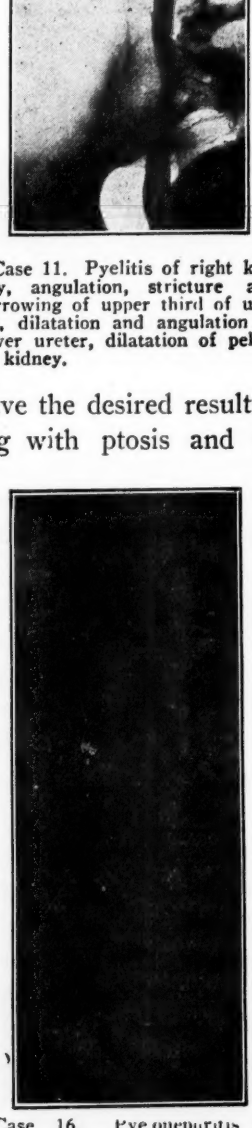
kinks of all degrees, associated with enlargement of the pelvis in cases of marked degree. Shadows of enlarged pelvis with straight lines at the ends of the calyces, and a change of the outline from the normal curved contour of this part of the kidney, indicated inflammatory processes of more chronicity.

In those cases at all amenable to treatment, dilatation and irrigation with solutions of silver nitrate

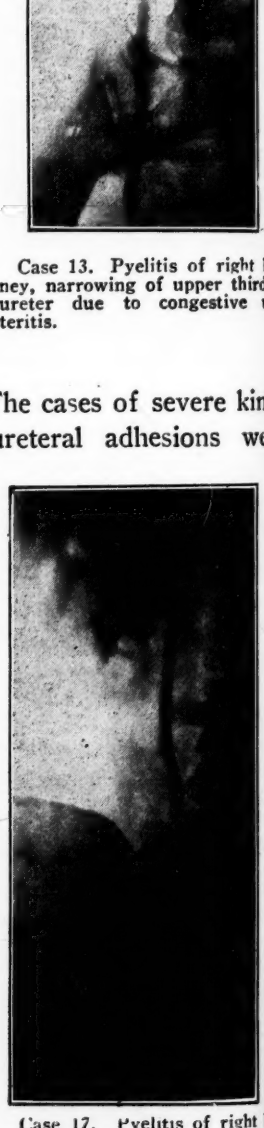
Case 11. Pyelitis of right kidney, angulation, stricture and narrowing of upper third of ureter, dilatation and angulation of lower ureter, dilatation of pelvis of kidney.

Case 13. Pyelitis of right kidney, narrowing of upper third of ureter due to congestive ureteritis.

gave the desired results. The cases of severe kinking with ptosis and periureteral adhesions were



Case 16. Pyeonephritis of right side, angulation of upper third of ureter, tortuous ureter and angulation and dilatation of lower third.



Case 17. Pyelitis of right kidney, constriction of upper third of ureter with ureteritis.

sometimes benefited, but these are the most troublesome.

The relief that can be given to some of these patients, who have been treated and operated upon

previously for conditions not present, is very gratifying. Especially is this true where the stricture is in the lower part of the ureter. Stricture close to the kidney, and marked ptosis of long-standing, are very hard to cure even by operation, because of the extensive fibrosis usually present, and so, again, the value of early recognition is apparent.

The tabulated report herewith is from a study of 50 cases, and is presented not to illustrate a positive conclusion, but to show the interesting facts, with the hope that it will stimulate further observation.

This series of cases was colleced in the spirit of research. At the time, the urinary symptoms were not taken into consideration and had no bearing on the motive. The majority of the cases were gynecological, and surgical reconstructive measures were performed for the relief of the common complaints of the female, viz., aching in the lumbar region and in the lower quadrants of the abdomen.

The symptoms of urinary disturbance were so slight that probably sufficient care in eliciting them from the patient was not observed. Our attention was not seriously directed to the urinary tract previous to operation, nor was it considered a possible factor in these cases.

The preliminary study of the urine at this time consisted only of the routine urinalysis and culture of catheterized bladder urine. Since this study, we feel sure of the existence of sterile congestions in one or the other kidney pelvis and ureter and now appreciate the necessity of more exhaustive study of the urinary tract, in that it reveals the condition which directs attention to the possible presence of an interference with the drainage of the renal tract.

These sterile congestions of the kidney, its pelvis and ureter, can be recognized by a close study of the catheterized kidney urine, which exhibits many epithelia from tubules, pelvis and ureter and frequently much blood, from one kidney, while urine from the other kidney may be normal. It is just such cases, and by a great number, that I fear are being misdirected in the relief of symptoms so common in the female, such as distress in the lumbar region extending into one or the other lower quadrants. These, in the majority, are more marked when in the recumbent position. Frequency of urination, while present in many cases, and at times quite marked, is not always found. In the more severe cases, vomiting frequently occurs, accompanied by dynamic contraction of the ureter and retention of the urine in the kidney with resultant renal colic.

This later study has convinced us that negative urinalysis coupled with a negative culture, does not preclude the existence of some pathological change in the urinary tract, and has shown us that exhaustive study of the latter previous to abdominal operations is to be desired.

Conclusions.

1. Obstruction of the ureter without infection, but with lowered resistance, is more often present than has generally been surmised.

2. This condition is a predisposing cause of pyelitis and pyelonephritis.

3. Certain organisms, as the colon bacillus, have a predilection for the upper urinary tract.

4. Routine urine culture is a valuable addition to the diagnostic armamentarium of the surgeon.

5. Early recognition and treatment of obstruction is highly desirable, for the long-standing cases are often incurable with measures in use at present.

6. Every gynecologist should be thoroughly familiar with the cystoscope for diagnosis and treatment or, at least, should be able to provide facilities for its use.

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DIMINUTION OF POST-OPERATIVE SHOCK BY PRE-OPERATIVE DESENSITIZATION.

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Theoretically, shock has been explained on the basis of hemorrhage, on over-stimulation of sensory nerves, lowering of surface temperature, acidosis from prolonged anesthesia, exposure of the intestines, psychic factors including fear, and pulpifying of tissue by trauma. Probably any one of the above factors would produce shock if excessive and the condition of shock would be immediate, in other words a distinction must be made between primary and secondary shock. This is better exemplified in the fact that we occasionally see a man with a traumatic amputation of a leg who does not exhibit shock immediately, but it gradually supervenes. This argues, therefore, that while intense primary shock may be due to nerve inhibition occasionally, at least, there is a secondary shock due to a slower absorptive process, and more difficult to counteract.

In a recent experiment Cannon, Dale and Bugliss found that destruction of muscle tissue causes a fall in the blood pressure when the nerve supply to the injured part is blocked; and that this fall is prevented when the circulation to the part is blocked. In other words, there is an absorption of muscle toxins through the circulation following pulpifying, which causes a distinct fall in blood pressure.

Suppose that we consider the reaction, that is, a rise of temperature and a quickening of the pulse

following surgical operations, as a degree of secondary surgical shock. This reaction begins usually from 12 to 24 hours after an operation, may last 12 to 48 hours, and gradually recedes to the normal. If this reaction then may be considered a degree, even though low, of shock, then we have something definite upon which to base conclusions. For instance, if by lessening hemorrhage, or lessening unnecessary manipulation, or by anoci-association, we find that the reaction following is lessened, then one may rightfully assume that the element eliminated or lessened is a causative factor, indeed. Upon this reaction being taken as a unit, therefore, let us review a few clinical experiences.

If *hemorrhage* were solely the cause of shock, or even the most important factor, then we would expect a severe reaction to follow the removal of blood from the donors in blood transfusion. This, however, has not been our experience; these patients seldom have a marked reaction and frequently have none.

Stimuli from nerve injury would be the next factor to consider. By proper anocithesia, however, we would expect complete control of the factor. This, however, has not proven to be entirely so, because even with careful anoci-association we sometimes see marked reactions following operations—and even following hernioplasties under local anesthesia, with no pain whatever, we always see a reaction.

Even avoidance *lowering of surface temperature* by properly heated rooms, etc., does not eliminate the resultant reaction.

Although the reaction increases in proportion as the *anesthesia* exceeds one hour, yet we find corresponding reaction following operations of short duration.

Destruction of tissue by rough manipulation, however, seems to be the deciding factor as regards the intensity of the reaction following surgical procedures. In other words, secondary post-operative shock becomes a personal equation—*and the intensity of the reaction following operation is in direct ratio to the trauma which we inflict.* By careful dissection and handling of tissues the reaction following may be reduced to a minimum. Clinically, at least, this is so. What, therefore, takes place which produces this reaction, or causes it to be produced and which, when more intensified, produces secondary surgical shock? We know that by the introduction of a foreign proteid into the body a similar reaction takes place, even though this proteid be non-specific. We do not have to stretch the imagination unduly, therefore, to theorize upon the absorption of protein material from tissue destruction. We also know that we are able by injection of proteid material to so desensitize the body that further protein injection will cause no reaction; in other words, it will lose its toxic properties for the human body. It is this principle of desensitization that we have attempted to apply to surgery, especially to the reactions following surgery and shock.

Non-specific protein immunization, as a principle, is not new. It has been used with satisfaction in such diseases as gonorrheal arthritis, influenza, pneumonia, puerperal sepsis, typhoid fever, etc., and it accounts for several cures of cancer with serum treatment reported in the literature. Up to the time (1916) that Schmidt and Saxl introduced intramuscular injections of milk, however, non-specific therapy was considered dangerous; at this time typhoid vaccine was generally used. The work of Schmidt and Saxl was quickly followed by that of Bruch, Muller and Weiss who began using 5 to 10 cc. of sterile, toxin-free milk intragluteally. They showed that this treatment is rarely followed by a chill, although one may occur, but it is followed in six to eight hours by a typical rise of temperature which subsides in twenty-four hours. By this method there is relatively little danger of anaphylactic shock. Mo guzzi in 1920 used this method in 19 cases and it proved satisfactory in every instance. He claims that while the non-specific method is not a substitute for the specific, both should be used.

This form of therapy, of course, has not been adequately explained. Probably the most widely accepted theory is the stimulation of the immunizing power of the bone marrow, as evidenced by the formation of new granular neutrophile leucocytes. Other theoretical explanations are the stimulation of non-specific ferments of the serum, leucocytosis, and an increase of red blood corpuscles. The curative and prophylactic results obtained, however, are so striking as to argue against the above theories and more for some specific reaction within the body.

Assuming that the rise of temperature and the quickening of the pulse following surgical procedures are due to destruction of tissue at the time of operation, and the absorption of protein material, we have attempted to desensitize every patient before operation by injecting non-specific proteins intragluteally. In the early series we used typhoid vaccines, but because of the severity of the reactions we began using toxin-free milk (5 cc., increasing to 15 cc.) Injections are made every 5 to 7 days, depending upon the reaction, and continued until there is no resultant leucocytosis. Usually two or three injections are sufficient. A leucocyte count and a

blood sugar test are made 12 hours following injection in order to discern any reaction that may not have caused a rise of temperature or a quickening of the pulse.

The number of cases studied to date is 100, including 25 of hyperthyroidism of which I shall speak later. Three hundred and twenty-five injections were used in the one hundred cases. One hundred and thirty injections gave typical reactions with the corresponding rise of temperature and pulse. One hundred and seventy gave a relative leucocytosis varying between 11,000 and 13,000 with a slight increase in blood sugar, while 25 gave no (discernible) reaction at all. In 48 cases studied post-operatively (all major operations) there was no reaction, that is there was no rise of temperature or increase in pulse (over 80) throughout the entire convalescence. In 20 the reaction was negligible, temperature not exceeding 100° and pulse not exceeding 90; while in 7 the reaction was the equivalent to a case without previous injections. The remaining 25 cases were of hyperthyroidism.

GRADUAL REDUCTION OF THYROTOXICOSIS BY NON-SPECIFIC PROTEINS.

Just how arterial or polar ligation influences reduction of thyroid activity is one of the many unsolved problems of surgery. It has always seemed to me that the reduction of blood supply or lymph supply was of secondary importance. Crile believes the beneficial effects to be caused by interference with the sympathetic nerves which accompany the superior thyroid arteries. I have felt that arterial or polar ligation acts as a vaccine; that is, the trauma induced during ligation causes a destruction of tissue and thereby desensitizes the patient. In other words, the operations of ligation are similar to graduated injections of toxin-free milk. I have been influenced in this belief because I have felt that the reaction following trauma or operation on any other part of the body produced a like reaction in these cases. In order to determine whether or not this is so, I previously took five exophthalmic cases in which ligation was distinctly indicated and in place of ligation I injected typhoid vaccine, a foreign proteid, and in each instance the patient improved sufficiently for complete thyroidectomy within a time limit similar to that following ligation. More recently I have used toxin-free milk in place of typhoid vaccine in 20 cases, with more graduated reactions and similar results. If it is sufficiently proven later that ligation acts by protein desensitization, then non-specific therapy will become the method of choice, because the dosage and the subsequent reaction can be more accurately gauged and the patient will be saved the annoyance of several operations and only one scar will be present, whereas now there frequently are three.

DISCUSSION.

While positive conclusions cannot be drawn from the number of cases studied and while the results were not uniform in all cases, yet I believe that the procedure described opens a wide field for clinical and laboratory experimentation. From the observations I have made, I firmly believe that by desensitizing patients before operation we will overcome or reduce the reaction following operation to a minimum, will make the convalescence easier, will obviate gas pains and will prevent, in a large measure, if not entirely, secondary post-operative shock. In hyperthyroidism and thyrotoxicosis I believe that it will displace ligation in a large number of cases and give us a safer treatment than ligation in the very severe type of cases in which we hesitate to perform ligation.

As this is but a preliminary report, a more detailed description of the findings, including blood pressure reading and animal experimentation, will be published later.

THE CURATIVE VALUE OF BLOOD TRANSFUSIONS IN POST-OPERATIVE MASTOID CONDITIONS.

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During the past few years (particularly since 1920, when there was an epidemic of mastoiditis in New York City), irregularities in temperature have occurred so often in post-operative mastoid cases, that one is on the lookout for them in almost all cases. In many such cases, the wounds look clean; in some of them, the mastoid wounds have healed, almost by primary intention, while the pyrexia was still going on.

How can one account for such temperatures? Suspicion is of course directed towards the sigmoid sinus. This suspicion is justified in cases in which the sinus was exposed at the operation but in many cases, not only was the sinus not exposed but it was found to be covered wth a hard, healthy plate of bone that showed no evidence of infection. In one or two of my earlier cases, where the temperature showed irregular variations between 99° and 106°, I was advised to explore the sinus; but as repeated blood cultures were negative and the sinus in each instance was covered with a hard plate of bone, I refrained from doing so and the patient was cured by other means. In spite of the repeated statements of other otologists and some bacteriologists that positive evidences of sinus thrombosis

have been found, even when the blood culture has been negative, I have persisted in my belief that no severe infection of the sinus, sufficient to warrant an operation, ever occurs without bacterial evidence in the blood. In other words, in many of these post-operative cases, the temperature may be due to some protein invasion of the blood, as pointed out by George Cott of Buffalo a number of years ago, or it may be due to some invasion of the blood stream, which invasion is overcome by the strong bactericidal character of the blood itself.

In an experience of many years, I have operated upon a number of sinuses, where the blood culture was positive, with good results; conversely, I have refused to operate upon many patients who ran intermittent temperatures after a mastoid operation, where repeated blood cultures were negative and where there were no evidences of sinus thrombosis, other than the elevation of temperature. All of this latter class of patients recovered and speedily, during the past few years, since I have utilized blood transfusion, so simplified by the Unger method. The citation of a few cases will prove interesting.

CASE I. During the winter of 1920, a child of two years was operated upon for an infection of the right mastoid process. The following day the temperature rose to 106°. As there was a marked infection in the left ear, the mastoid on this side was operated upon. No sinus or dura was exposed on either side. The sinus plates were hard and healthy. Two days later the temperature went down to normal, to rise again to 106° that evening. For the next five days, the child ran an intermittent temperature between 100° and 106°. There was no pyelitis, no evidence, at that time, of pneumonia; the throat was clear. Numerous consultations were held and an exploration of the sinuses advised. I refused to expose the sinuses, first because I did not know which sinus to attack and second because the bony plates over the sinuses were hard and healthy. A transfusion of blood was decided upon. Four hundred cubic centimeters of blood were given, whereupon the temperature dropped to normal, to rise again a few days later when a broncho-pneumonia developed. The child recovered and to-day is strong and healthy.

CASE II. A girl of six, developed a bilateral purulent, otitis media. The ears had been running for ten days before she was first seen. There was every evidence within the ear canals of a mastoiditis on both sides, although there was no pain or tenderness over the mastoid processes. The child had no fever but she looked sick. Unfortunately, consultation developed a difference of opinion as to whether it was an operative case or not, even after *x*-ray pictures showed some breaking down of the cells. Delayed operation showed considerable destruction of the cells on both sides, but for the first ten days after the operation, the child did exceedingly well. On the tenth day (a time when one expects the first symptoms of sinus thrombosis to show themselves), the temperature rose to 106° and there was a chill. The blood culture was negative. The urine was negative. The chest was negative. The child complained of difficulty on swallowing which was found to be due to a peritonsillar abscess on the left side which opened by itself, whereupon the temperature went down to normal. A few days later, the child was sent home. That same night, the temperature again rose to 106° and there was a chill. On three successive nights the same symptoms occurred. Repeated blood cultures were negative. Finally a transfusion from the father was decided upon. At the time of the transfusion, the temperature was 106°. Four hundred cubic centimeters of blood were given. The temperature dropped to normal after the transfusion and remained there. During the past three years, the child has remained absolutely well.

CASE III. During the time that the child above referred to was in the hospital, I was taking care of an adult female who had had a simple mastoid operation performed from which she made an uninterrupted recovery. She left the hospital at the end of the tenth day but was forced to return because she began to run a temperature up to 104°, with a chill, every other day. Between the rises in temperature, she felt perfectly well. Repeated blood cultures were negative. Both typhoid fever and malaria were ruled out. A gynecological examination was negative. She complained of no pain around the ear and there were no evidences of blood invasion, other than the rises of temperature. These persisted for three weeks, sometimes occurring every day, sometimes every other day. A blood transfusion was suggested and she was given 500 cubic centimeters of blood from her twin brother. There was never any rise in temperature after the transfusion and now, after two years, she is perfectly well.

CASE IV. In February, 1922, a boy was brought to New York from another city. At the time of admission to the hospital he had a mastoiditis on both sides and a severe bronchitis. His temperature was 105°. There had been a profuse discharge from the ears for over two weeks. Both mastoids were rapidly exenterated. A speedy operation, under chloroform anesthesia, had to be performed on account of the lung condition. The wounds appeared to heal nicely and the patient seemed to be on the road to recovery. On the twelfth day, he began to run an irregular, intermittent pyrexia. Blood cultures were repeatedly negative. The lungs still showed some signs of bronchitis. The urine boiled almost solid with albumin. The boy was drowsy and listless. Spinal puncture showed the cerebro-spinal fluid under pressure but the culture was negative. The boy appeared to be so ill that the majority of consultants called in gave a hopeless prognosis. At the end of the third week, a transfusion was decided upon. About 600 cubic centimeters of blood were transfused into him from

a suitable donor, by the Unger method. The temperature the following day was normal and it remained normal. At the end of another week, he left the hospital in good condition.

The few cases above cited are sufficient illustration of the value of blood transfusion in postoperative mastoid cases in which there is an irregular intermittent temperature which cannot be definitely accounted for. They are but a few of the cases I have seen. Exactly what effect the transfusion has on the infectious process, it is hard to say. Apparently the blood has certain bactericidal properties and, when the resistance is good, it is able to take care of infection; but when the resistance is lowered, it is unable to cope with the situation and some outside aid must be sought. The transfused blood not only gives new life to the patient, increasing resistance but, by its bactericidal property, it is able to overcome the infection present. Because of the success met with in these cases, I strongly advise blood transfusions in all postoperative surgical conditions in which there are intermittent temperatures, that cannot be accounted for.

2178 BROADWAY.

REMARKS ON CARCINOMA OF THE RECTUM.*

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According to vital statistics there is a steady increase in the prevalence of carcinoma throughout the civilized world. In 1840 the proportion of deaths from cancer to those from all other causes was 1 to 129. By 1900 this ratio had increased to 1 to 23. At present, according to the latest United States census reports, cancer causes about one-tenth of all the deaths reported. In the two years that the United States was recently at war, eighty thousand of our soldiers and marines overseas died either from injury or disease. During the same period one hundred and eighty thousand people died from cancer in the United States. In 1920 about one hundred thousand deaths occurred from cancer in the United States.

Of all the cases of cancer about 6% occur in the rectum and sigmoid, and this alarming frequency of the disease is my only excuse for presenting a paper on this subject.

The growth may be a squamous-, adeno-, medullary- or scirrhus carcinoma, depending upon the location in the rectum and sigmoid. About 10% of the growths may be classed as anal; 18.5% as above the anus but below the peritoneum; 56% above the line of the peritoneum; and the remainder are in the sigmoid. These figures are highly important from an operative standpoint, as one will observe that in over one-half of the cases the growth is situated above the peritoneum. Age is frequently considered a predisposing factor in the cause of cancer. The maximum incidence of cancer is found between 40 and 45, but it may occur at any age. Males are affected more frequent than females with cancer of the rectum in the ratio of 3 to 1.

Hemorrhoids, colitis and constipation frequently precede the discovery of cancer of the rectum, but in the light of our present knowledge they have little to do with its etiology. Traumatism may be considered a factor.

A few years ago, when the importance of going into the history of constipation and of examining the rectum were neglected, a carcinoma of the rectum had usually progressed to an extensive size and caused obstruction before being definitely diagnosed. Now with a more careful history and physical examination, proctoscopic examination of the rectum (under an anesthetic if necessary) and *x*-ray examination, cases are discovered earlier and oftener.

The symptoms of cancer of the rectum and sigmoid vary from indefinite digestive disturbances to obstructive manifestations, depending upon the nature of the growth, its location, size and extent. In the beginning, perhaps slight indigestion with constipation or even diarrhea, coupled with vague discomfort or slight painful sensations referred to the region of the sacrum, are all that are present. Later there develops the "morning diarrhea". In this the patient is troubled during the day with frequent desires to defecate, while during the night he is comfortable and does not have to arise. Later, and when the disease is developing seriously, immediately upon arising in the morning he has a forceful dejection, consisting of blood, mucus and pus and perhaps a small quantity of fecal material. A little later in the day the patient has a good bowel movement, but the rest of the day he is annoyed by frequent attempts to defecate.

This brings up the question of blood in the stools. At first there may be simply a few drops now and then, while later black coagulated blood and bright red fresh blood are passed in considerable quantities. Pain is a variable symptom. Its presence is usually indicative of a moderately extensive growth and so its value as a diagnostic symptom is slight.

*Read before the Schenectady County Medical Society, April 11, 1922.

Constipation is not always the rule with cancer of the rectum and sigmoid, but may be replaced by diarrhea or at least attacks of the two alternating. In the earlier symptoms, the diarrhea attracts our attention first.

The general physical examination should be thorough to determine the presence or absence of metastases. These may occur in the groin, abdomen, liver, lymphatic glands and other abdominal organs. A careful digital examination of the rectum should be made, bearing in mind that a negative examination may be due to the fact that the growth is situated beyond the reach of the finger. My old instructor used to say that one of the chief duties of a consultant was to look wise and put his finger in the rectum. We often avoid this pitfall by using a proctoscope or sigmoidoscope, inflating the rectum so that we can visualize fully the entire surface of the rectum or sigmoid. By this method it is possible to diagnose lesions that would otherwise escape our attention. However, do not be misled by the over-enthusiastic pathologist who requests a biopsy, as this is a most dangerous procedure.

Lastly as a diagnostic method comes the *x*-ray with the use of a gastro-intestinal series and more especially the barium enema. In passing, it might be worthy of note that often in growths of the rectum and sigmoid, great difficulty is encountered in injecting the barium or in having the patient retain it after injection.

I have met a few cases, particularly in elderly men, where it is not easy to make the diagnosis of cancer of the upper portion of the rectum, especially if there has been a displacement and a lax condition of the sigmoid, which will sometimes drop down deep in the pelvis and where there are no discharges of blood and some of the other more marked symptons of intestinal trouble. The patient may present some bladder iritation and have an enlarged prostate. The suspicion that he may be developing a carcinoma of that gland is upper most in our thoughts. One case in particular I call to mind, where we had made the diagnosis of involvement of the prostate, and while the patient had never had absolute obstruction of the bowels, yet he had had some of the symptoms, such as diarrhea, that could not be accounted for very well, with the forenoon desire for a movement. At autopsy it was found that the origin of the disease was in a loop of gut closely connected with the sigmoid. This same condition occurs in the female in connection with a fibroid in the posterior wall of the uterus; a diagnosis is sometimes made of malignant development in the uterus, and it is later discovered that in a prolapsed portion of the descending colon is the origin of the disease. In these doubtful cases a very earnest effort should be made in using the bismuth or barium *x*-ray method of examination. A cystoscopic examination of the bladder is of some aid as well as a careful measurement and examination of the uterus in the female.

It is only a few years since textbooks were published by specialists in which they gave no encouragement whatever regarding radical operation in carcinoma of the rectum. Some patients, they maintained, were made more comfortable and lived longer under the use of opiates and palliative treatment with no surgical intervention until acute obstruction presented, and then the patient's condition was such that doing a colostomy was akin to operating upon a person facing dissolution. A very small percentage of cases were helped somewhat, but the operation was looked upon by the patient and friends as offering little hope.

Today operative methods at our disposal for treatment of these cases are varied and depend to a large extent upon the location and size of the growth. I am convinced we should make greater use of a colostomy in some form as a preliminary procedure, especially in the more advanced, or doubtful, cases. In so doing we can bring the patients up to better physical condition for a more radical procedure. They usually improve in strength and in morale, in a very impressive manner. This improvement gives confidence to the patient for further surgical interference, if advised, and inspires greater hopefulness of ultimate recovery.

One word as to right inguinal colostomy, or cecostomy, as it may be called. The beginning portion of the ascending colon is so easily reached, and so easily attached as an artificial anus, that I am rather in favor of endorsing it as a selective procedure in these cases. It is possible we have yet to improve the formation of the artificial opening and I believe this field presents encouragement for further research.

Resection from above through the abdomen with pulling down of the remainder of the sigmoid may be done. This procedure is more appropriate and possible only in cases seen early and where no large mass presents. From below we may attack the growth either by the vaginal, perirectal or the sacral route. Any one of these usually means a subsequent loss of sphincter control and the sacral operations require a resection of the coccyx and part of the sacrum. In this connection one must take into consideration that the resection as done in the Kraske operation, which for so long a time was a

very popular operation, is accompanied by a moderate degree of shock which in a patient weakened by illness may prove fatal. These are the cases in which colostomy is very beneficial at times.

In addition to surgery, radium and *x*-rays are valuable. With the former, I have had some success. With the latter, I have had little experience, not being encouraged in the few cases so treated.

To my mind there is no one treatment applicable to all cases. I personally consider it wise to do a preliminary colostomy on practically all cases. This accomplishes two main purposes. First, it affords an opportunity to actually determine the extent of the growth and of its metastases, if there be any. This is very important, for in many cases there are metastases in the liver; finding these we know that further operative measures are useless. Second, a colostomy gives the patient an opportunity to improve before the second operation is done and allows the involved area to quiet down somewhat with no irritating feces passing through the zone of operation.

The type of secondary operation fitted to the case will depend upon the nature, extent and location of the growth. If there are abdominal or other distinct metastases no further surgery is indicated. If these are not present, and the growth is above the peritoneal reflection, it should be resected abdominally and, if possible, an amastomosis done by bringing down the sigmoid.

Possibly, this statement regarding this type of operation should be modified somewhat. Unless the colon is free, with little strain upon it, especially when the Murphy button is used, I am of the impression that unless an anastomosis of some portion of the upper bowel to the lesser rectal segment, can be made, the whole diseased mass had better be side-tracked and not resected and the patient made as comfortable as possible with an artificial anus. In the doing of this operation we must ever keep in mind the possibility of a visceroptosis being present to give us some aid. If the growth is well down in the rectum, then it is often possible to remove completely by the lower route and either bring down the rectum to the anal margin or create a new anus higher up on the back. I have seen a few patients in my father's practice as well as my own, made very comfortable, and living years after this type of operation. In some instances it will be necessary to work both above and below in order to perform a successful operation.

With a colostomy the patient may be at ease for even years. It is surprising how these people learn to care for their bowels by keeping them somewhat constipated and relieving them daily with soapsuds injection into the colostomy opening.

I feel that in all patients that have been obliged to submit to a colostomy which has remained permanently and who afterwards die of some other complication or disease, there should be a careful examination made of the specimen, after death, for in some instances the patient has been so contented that I have been doubtful regarding my diagnosis.

In many of these cases, and in inoperable ones, great benefit is derived from radium applications. After the colostomy is performed the growth can be treated with radium and if inoperable, the patient is made more comfortable due to lessening of the pain and the discharge. If further operative procedures are intended, radiation of the growth following colostomy is very wise as it seals the lymphatic channels, shrivels the growth and minimizes the likelihood of the metastases due to manipulation of the growth while attempting its radical removal.

Now we come to a discussion of the results obtained by operations of the above character. How long will the patient live and can you hold out any hope of a cure, are only natural questions.

Far advanced cases, where any radical operation is contraindicated, live six to eighteen months after colostomy and can be kept comfortable with or without radium treatments.

In the moderately advanced cases, where there is no evidence of metastases, the prognosis is fair if a wide removal of the mass is done. There is usually absolute relief from pain. The expectancy of life is certainly beyond three years, many patients dying of some other malady.

In the early cases the prognosis is good. Their expectancy of life is about ten years and many of us have patients alive and well today who have survived more than ten years. In connection with any estimate of expectancy of life, it is only fair to refer back to the tables which show that cancers of the rectum are more commonly found between 40 and 45, at which period of life the death rate in normal individuals is at a fairly high level. An early diagnosis aids any form of operation. Great and valuable information is gained by a thorough study of the appearance of the stools, without waiting for the appearance of blood in the stools before making our diagnosis.

28 EAGLE STREET.

A mass protruding from the rectum of an infant or child may be an intussusception and not a mere prolapse.

CERVICAL SYMPATHECTOMY AS A MEANS OF STOPPING THE PAIN OF ANGINA PECTORIS.

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Some years ago the author wrote a brief article on cervical sympathectomy as a means of permanent cure of trifacial neuralgia; since them Jonnesco, of Bucharest, has applied the identical operation for the relief of the pain of angina pectoris. I have performed the operation upon four patients, in all of whom the pain was checked at once. Three of them are living and the fourth died from postoperative pneumonia, evidently caused by inhaling the vomitus while on the operating table.

The operation consists of exposing the cervical sympathetic nerve, following the procedure of Jonnesco, which is identical with the procedure described and illustrated by C. H. Mayo. Jonnesco removes only the nerve of the left side, together with its ganglia. The results in his hands have been good and the operation has more than a palliative action. As the final, fatal outcome is due to auricular fibrillation and heart block or to reflex action, the suppression of the paroxysms of pain does away with the usual cause of the sudden death in the cases of aortitis, affecting mainly the origin of the vasa, where the network of nerves is especially close and the pain is exceptionally severe.

A factor of great value in the speedy performance of the operation is the use of the Crile screw clamp on the common or external carotid artery. A bloodless field is thus at once secured and the nerve can be rapidly removed. The screw clamp should be opened very slowly, so that any bleeding point can be secured at once and hemostasis maintained. It is possible that the remarkable relief which follows this procedure is due to the fact that the parts where the pain is located are suffering from anemia and the cutting of the sympathetic produces a vasoparalysis with a subsequent vasodilatation, so that the anemic parts become permanently flooded (ad maximum) with blood.

It is to be understood that the operation is not to be considered as a cure of the disease, which is the cause of the angina, but the excruciating pain is relieved though the disease runs its natural course. Even this is a gain. The only way to watch the action upon the heart after sympathectomy is by the study of sphygmographic and plethysmographic tracings, which will be published in a later article.

I have practiced this operation for a number of years on several dozens of patients suffering from trifacial neuralgia and have met with no-ill effect attributable to the operation, provided certain precautions were taken; these have consisted in following Crile's advice of giving a preliminary hypodermatic injection of atropine sulphate some half-hour before operating; the other precaution is that of avoiding traction on the vagus (the pulse beats drops perceptibly and at once). Packing pledgets of cotton saturated with a two per cent. solution of cocain makes the heart beat promptly return to normal (the atropine paralyzes the vagal terminals and thus prevents cardiac inhibition).

Medical treatment in general has yielded but meager results in angina pectoris, yet the endovenous administration of quinine and urea (grain 1.0) has given excellent results. It has a sedative action on the center in the medulla, for the pneumogastric and the accelerators, hence its good action for angina pectoris. Very often the pain of angina and the tachycardia have been greatly relieved by pressure on the eyeballs for a few minutes (oculo-cardiac reflex).

Jonnesco recommends operating only upon the left side, but I have operated upon several patients suffering from bilateral facial neuralgia on both sides, and no ill-consequences resulted.

I have operated upon a few cases of persistent tinnitus aurium and in some instances the relief was instant and permanent, no other surgical procedure being employed.

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BELDING BLDG.

ROENTGEN DIAGNOSIS.

Over-confidence in the simplicity and accuracy of roentgenologic diagnosis is shown in the too common acceptance of diagnosis made by technicians. Examinations of the blood, sputum, and urine can be made by technicians because these tests are relatively simple and the results are reported chiefly in terms of fact. The diagnostic interpretation is really made by the clinician, a doctor of medicine. Many technicians make excellent roentgenograms, but these should likewise be interpreted by a physician. A thorough knowledge of anatomy, physiology, and pathology and a broad acquaintance with the whole science of medicine are absolutely essential for the reliable translation of roentgenologic signs into terms of diagnosis. Roentgenology is for physicians and should be practiced by physicians.—RUSSELL D. CARMAN in *New York State Journal of Medicine*.

THE PRINCIPLES OF FRACTURE TREATMENT.

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(Concluded from November issue)

Osteosynthesis is the term applied to joining of bones together by surgical means. It is effected by the use of a great variety of materials in a vast number of forms. The various devices are absorbable or non-absorbable, buried or partly buried and partly extraneous to the body. Sutures are of catgut, kangaroo-tendon, silk, linen, or wire of various metals. There are used bands, pegs, bolts, plates, screws and nails of wood, ivory, bone, iron, steel and silver, as well as various devices composed of the patient's own tissues such as bone, tendon, and aponeurotic sheets and ribbons.

Of course, a practical acquaintance with these devices is of high importance to the worker in this field, but at least the principles involved must be firmly grasped before their use is undertaken. The fact that surgeons accept no fixed rules to guide them in the choice of materials, devices and methods makes great difficulty for the inexperienced worker and gives latitude for wide variation in the practice of different men. Furthermore, in the different countries of the world, varying sets of procedures are in favor, surgeons adapting themselves to methods and materials instead of the converse course. No man should undertake this work without having served apprenticeship under an accredited surgeon.

I am strongly of the opinion that every surgeon should be truly above nationality and local prejudice in his scientific knowledge and practice. He should know the methods of surgeons in all lands and fearlessly choose for his own uses those which best suit his own needs, his own temperament and knowledge, ignoring the mere fashions popular among those about him.

Many surgeons have the impression that, when an open operation is performed for reduction, an osteosynthesis is imperatively to be added. Nothing could be further from the truth. *Open reduction of a fracture is frequently needed and should be performed where no fixing or synthetizing procedure is required.* Every surgeon knows the great importance of leaving wounds such as we are considering in the simplest and most favorable condition possible for healing.

Especially would I emphasize the great importance of avoiding, as far as possible, the use of foreign bodies to be left in the wound. And obviously non-absorbable bodies are the least desirable materials to be placed there. The great metallic masses involved in the Lane plates with screws are an abomination, only occasionally unavoidable.

The ideal goal of surgical effort in the treatment of fractures is that of attaining healing with no more than the replacement of the parts in normal relationship. The use of wires and plates is a confession of our defeat in applying our art to the case in hand; it is not a triumph. And the perusal of such a work as that of Pierson will convince the impartial reader that the more one's personal skill is developed to suit the exigencies of practice in individual cases, meeting and overcoming the difficulties encountered in the way of distraction, of misplacement of fragments and of immobilization of the bone, together with the provision of movement for the neighboring joints, the less will one find himself compelled to operate by open methods.

Again it is the occasional or amateur operator who most frequently feels that he must open the tissues over a fracture. The experienced and well-equipped man knows what he can do with the apparatus his forethought and practice have provided, and, with confidence he proceeds to the management of such difficulties as those of overlapping and angulation by the application, let us say, of the skeletal traction principle, finding no need to use the knife. And, of course, it is the amateur who is most likely to meet with operative disaster, while the very man whose skill would carry off with success an open operation, oftenest finds it wholly unnecessary to perform it!

It is especially the purpose of this paper to lay stress on these points in treatment. For it is felt that a just comprehension of the true principles of treatment as we know them today will cause many a man to change his method from an operative to a manipulative effort.

The principle of osteosynthesis is a difficult one to grasp in essence—to get into one's working, inner surgical consciousness, so that it is part of his true equipment of surgical judgment. Let us consider:

A bone fifteen inches long is broken near the middle and the surgeon applies a wire, a plate or band to hold the ends together. Is there not an enormous leverage exercised at the points of osteosynthesis? How little angulation or bending of the limb during the application of the dressing would be required to tear out the screws of a Lane plate or nullify the action of a wire or band? We have to bear in mind that the mechanical fixing power of these devices is, *per se*, slight indeed. And it is equally to be considered that it is upon external support and fixation that we must depend in the last analysis. Hence, if no very great tendency to displacement exists, the

operative intervention *will best end with simple reduction.*

Retention of the parts in their proper relationship is of the utmost importance for healing. It demands the warding off of external traumata and the fixation of the parts by some externally applied fending and supporting apparatus. The choice of apparatus depends on the predilections of the surgeon.

During the recent war English surgeons used the Thomas splint quite extensively. Yet the Germans had excellent results with plaster of Paris and various splints. The French under Calot used plaster; under Delbet they used that surgeon's extension splint; under Hennequin they applied his elaborate apparatus, and so forth.

The method chosen must be adequate, and it must be one with which the surgeon is familiar, and in the use of which he has acquired skill.

There are advantages and disadvantages in them all and the secret of success lies in the wise choice of an adequate method and the assiduous, diligent, watchful management of the injury during the weeks and months required for healing, together with the frequent study of *x*-ray plates carefully made in planes cutting each other at right angles.

The principle of *mobilization* is that upon which the restoration of function next depends. If the physiological needs of the limb are ignored the mere healing of the bone will sometimes be a mockery, and frequently will be unsatisfactory because it will not be associated with free and strong action of the limb as a whole.

Malgaigne, in his celebrated work on fractures, my edition of which was published in 1855, called attention to the fact that the sufferer from fracture of the femur might move about a little in bed and even use the bed-pan without preventing healing from occurring. And Lucas-Championnière in more recent years has insisted that the orderly manipulation of the tissues about fractures hastens healing instead of preventing it. Indeed, the profession today quite generally admits that we must abandon the old notion that absolute fixation is desirable or necessary. Bier emphasizes the advantages gained by practicing the hints to be attained by the study of Roux' law, so-called. This law attempts to express the well-known principle that structure tends to be supplied wherever a need for the performance of a function manifests itself.

My own practice in all fractures is to have massage made use of from the very first. But it is undesirable to utilize, in these important cases, the services of any but the most skilled workers. And I have had the greatest satisfaction in the cooperation of graduates from the best institutions of Stockholm, Christiania and Copenhagen.

Slight movements at the neighboring joints, massage in its various forms about the whole limb and, later, active muscle-flicking and resistance exercises are of great importance. Fractures of the humerus and femur will do well under the influence of active movements of the fingers and toes which maintain the vitality of the nerves and the vascular systems of the extremity even if a part of the limb is quite strictly restrained. All real students of fractures at this time are practically agreed upon the beneficence of such practices. But, unfortunately, at the bedside we see, only too frequently, the failure of the clinician to apply the method in the case in charge, with the result that stiffening and retraction seriously mar the outcome, even if the bone has united.

Unfortunately there are surgeons who think that massage is unnecessary if only the patient becomes able to use the limb so that muscular action and bone movement may empty the veins and lymphatics. Even Sir Robert Jones (Inquiries to Joints, p. 14) leans to this unfortunate opinion.

This is not true. No intelligent surgeon would wish to replace voluntary activity by massage. But massage has its necessary place if we would promptly and thoroughly heal. The reason lies in the fact that almost always about fractures there are deposits of edema that are influenced almost not at all by ordinary physiological activity, while direct rubbing out or emptying of the lymph faces and vessels enables the tissues to reestablish themselves in their normal routine of life. Neglect of massage, this gently forcible emptying of the damaged tissues, restores sufferers and prevents the formation of deeplying scars where the infiltration existed.

Restoration of function, granting permission to use the limb involved, demands the utmost care on the surgeon's part. For, if he permits weight-bearing too soon, the soft callus will yield. And, if later than necessary, he not only wastes his patient's time but also defers the opportunity to put into activity all the tissues of the limb, which suffer in serious measure from disuse. Even more or less retraction may occur.

When it is begun, passive motion and more active massage precede resistance exercises and full joint movements. It is at this time that the masseur is best able to search out all the tender areas, all fields of bacon-like edematous infiltration and, perhaps with some momentary discomfort to the patient, press the tissue-juices out each day until the dam-

aged structures are again able to hold their own under the growing demand for full usefulness. Nor should the patient be allowed to be free of the surgeon's observation until the maximum function is attained and the tissues involved have regained their normal quality. In the worst fractures a year may pass before all the possibilities of improvement are exhausted, although the surgeon probably will not need to see the patient often toward the end of the treatment.

National tendencies in the management of simple fractures constitute not only an interesting but an extremely profitable topic of study. The German-speaking countries have viewed fracture-treatment in their own way. While they have recognized the general principles of treatment satisfactorily enough they, naturally, have developed their own technic.

First, in the matter of extension by adhesive plaster, derived from America and popularized in Germany several decades ago, they have made remarkable progress. This method is adequate in most of the easy cases demanding simple opposition to muscular action. Bardenheuer has taught and written upon the method for many years, having developed it by assiduous attention in a great number of cases. Grasping the notion that the annulment of spasmodic muscular action is a necessity in freeing the fractured bone from such interference as will prevent vicious union, he learned how to apply the plasters in such a way that weights up to seventy pounds were tolerated.

The great advance involved in the use of the skeletal extension principle is to be credited to the Swiss, Steinmann, who, beginning his work in Zurich, was called later to Munich University, so that his communications in German, particularly his book on nail-extension, have had a profound effect on the practice of bone surgery.

Another Swiss, Zuppinger of Zurich, has had a similar and only less pronounced influence in the field of fracture theory and management. In his book he recurs to the recognition by Percival Pott, in the early part of the eighteenth century, of the great principles of dressing fractures in semi-flexion, of applying only such dressings as can be removed without undue manipulation of the limb and the principle of putting at rest the joints nearest the fractured bone.

It is true that Avicenna in the eleventh century, Guy de Chauliac in the fourteenth and Pfolsheundt in the fifteenth century had practiced permanent extention. But, as Zuppinger remarks, a popular, general application of adhesive extension could only be brought about after the introduction of good plaster. The American rubber adhesive plaster supplied the need. VonVolkmann deserves the credit of introducing it from America into Germany and popularizing its use. The overhead support of the "Balkan frame" type was in use at least as early as 1842.

Arguing with other surgeons not concerned with the controversy waged about the relative merits of mobilization and massage on the one hand and exact anatomical reduction on the other, Zuppinger demands, as indeed do Steinmann and others—and I heartily endorse the idea—that both ideals can be simultaneously pursued and, to a large extent realized.

Zuppinger insists that it is only in the first hours after a fracture has occurred that the muscles can be caused by treatment entirely to regain their normal condition.

Furthermore, he demands the placing of the limb in such a position that no tension can result in the spasm of muscles and their consequent shortening and eventual contracture. Zuppinger meets these requirements by the use of a double-inclined, jointed frame upon which the limb lies in such a manner that the weight of the part causes extension to be made. This leaves the surgeon great freedom for the application of massage and passive motion, while the limb is in the desired position of semi-flexion.

Active movements of the limb are considered of great importance, and this leads to the prompt but gradual resumption of the patient's ordinary occupation when the surgeon has decided that union is sufficiently strong. As adjuvants to callus-formation, hot-air and sunlight are recommended by Zuppinger.

The French have been early and enthusiastic students of fractures and their treatment. At the moment the influence of several French leaders is felt. Among them I have mentioned Lucas-Championnière who for many years advocated such fixation management of fractures as would leave the operator free to use massage and passive motion. The whole world of surgeons has profited by the long continued and brilliant teaching of this devoted enthusiast. With him, I must insist upon the great value of massage. It keeps in physiological activity the special tissues of the part, of course; but, a matter of capital importance, it rids the part of collections of effused blood, of deposits of edematous material, and it promptly disposes of those infiltrations which are so prone to result in contractures and periosteal thickenings. In children it may be grant-

ed that the tissues take care of these difficulties fairly well, but even here massage aids greatly. In adults massage is practically indispensable if one demands the best results.

Of course it is in fractures of one of the bones of the forearm or of the leg, and in similar situations, that opportunity is best afforded for the free applications of massage. Yet it is rarely that we do not find it possible to utilize massage to some extent during healing, while practically always it is of prime importance and value during the final stages of consolidation and the period of the incipient resumption of function.

During the recent world war the surgeons of France eagerly aided in the great work by writing useful and practical treatises on the special topics involved in the care of wounded. The work of Calot, the well-known orthopedist, interests us greatly. He insists that plaster of Paris is the sovereign material with which to manage fractures and he molds it with admirable art to the requirements of disabled limbs. He shows how it is to be used to support the shafts of the bones and he lays especial stress on the molding of the material about the prominences of the bone-ends and the tuberosities that afford points of support and resistence.

One does not doubt the success of this method in the hands of its advocate. But its disadvantages are very great. Aside from the great difficulty involved in the primary application of the cast in such a way that no failure of support will take place and no deformity will occur on account of the loosening of the cast with the shrinking of the volume of the limb as the progress of muscular atrophy takes place, there is the great danger to future function involved in the fixation of joints and the hiding of the limb in such a way that manipulations to maintain vital action are impossible.

The management of simple fractures by closed casts may be tolerated; excellent results are obtained by their use in suitable cases. But the tendency to the use of casts should be checked, I think, as much as possible, while dressings that are readily removed to give access to the part are infinitely preferable. And those that give such access without the necessity for removal at all are more nearly ideal.

The influence of Hennequin is exercised in a different way. In his work on Fractures of the Long Bones he presents the merits of his own very interesting apparatus—a sort of hammock for the limb slung from rollers sliding on metal rails. But he also recommends and uses other forms of apparatus and discusses the management of fractures from several viewpoints. The works of Hennequin are often quoted not only in the French literature, but in that of German-speaking writers.

Of unusual interest is the activity of Delbet of Paris, whose books and collaborative activities are numerous and always perspicuous. Delbet especially deserves credit for devising apparatus for making extension upon fractured bones by the action of metal springs. The treatment of fractures of the long bones by means of Delbet's apparatus gave excellent results in the multitudinous cases occurring during the war. It is most illuminating to read his account of his work.

Tanton has also written extendedly on fractures and in a manner not hampered unduly by adherence to personal views or methods.

All these French writers, except Calot, recognize the validity of the principles which I have here set forth in the matter of reduction and of treatment in such a manner that restored function is kept in the foreground of attention at all times.

The *principle of osteosynthesis,* as I have said, is to be brought into application only where bone fragments cannot otherwise be kept in apposition. Such cases, although not rare, are uncommon. They involve but a small proportion of the general run of fractures. Yet, occasionally one meets with injuries near the ends of the bones, as where muscle attachments draw heavily on short fragments, in which the only mode of retention is by the use of some internal fixing mechanism. Only when the requirement is really imperative should we yield and apply a foreign body. Then the rule must be to choose bodies small in mass; such as are not likely to be or to become irritating on account of chemical composition, shape, size, or length; such as are partly or wholly absorbable, if possible, like ivory, or dead bone; such as, if metallic, shall be, as nearly as possible, wholly resistant to physical or chemical action of the tissues and fluids and are strong enough not to be broken under strain. This would mean that wires are to some extent objectionable because they may become loosened and press into the tissues; that metal screws are likely to become detached and act as foreign bodies; that steel plates are not wholly resistant to solution and corrosion, that silver is a less undesirable metal than steel, and that ivory and dead bone have a small but legitimate place in our technic.

We owe to Albee of New York a special debt for insisting constantly upon the supreme desirability of autogenous material in bone work; that it shall be from the patient's own living tissues and that the repair of bone lesions shall be effected, if possible.

While by the use of the armamentarium he has devised, and the ingenuity and skill he has displayed, almost all the requirements of fracture treatment may be met, it is to be admitted that most of us prefer to reserve for occasional use the tried devices of catgut, kangaroo-tendon, simple bone and ivory appliances. Silver wire, bands, screws and plates and even steel screws, plates, etc., should be at hand for occasional application.

While the principle of osteosynthesis is admitted, yet its application is far more honored in the breach than in the observance. The true place for the application of our skill lies in the devising of ways to effect our ends in individual cases without the use of foreign bodies.

And I am fully convinced that all the exigencies of reduction, retention, mobilization, the maintenance of function and the restoration of normal usefulness are at this time so well provided for by the energy of our confréres in surgery that almost all fracture cases can be managed in comparatively simple ways and, by them, can be brought back to usefulness and strength.

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INCONSISTENCIES IN GALL-BLADDER SURGERY. CHOLECYSTECTOMY VS. CHOLECYSTOSTOMY.*

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A kind criticism is never harmful; it is stimulating to thought, it is constructive and conducive to better results as it takes us out of the trodden paths of habit which may have been acquired by fad or fashion that are quite void of surgical principles. The processes of substitution have been most destructive to clear reasoning in many of the urgent lesions of the abdomen. To follow the line of easy travel in abdominal surgery has to me been tragic in its results. Years ago I called attention to the excessive removal of gall-bladders. At this hour the literature is overflowing with discussions of the relative merits of cholecystostomy and cholecystectomy and I am gratified today to see the pendulum swinging back in favor of cholecystostomy.

Our profession always pays a costly price for a misadventure into unsurgical principles, but the compass brings us back to solid surgical principles in the end. There are very few organs in the body that can be removed, unless hopelessly diseased, without the patient paying the costly price and that inevitable law of compensation always demands its toll.

The discussions of the relative mortalities of cholecystostomy and cholecystectomy have not told the true story. If the handwriting could be placed on the wall taking into reckoning all the operations done in this country by these two procedures, the death rate would be at least eight to one in favor of cholecystostomy. There are, of course, a few operators who most uniformly remove the gall-bladder who would show a more favorable result for cholecystectomy, but even their relative results are unintentionally distorted in favor of cholecystectomy. I have been much impressed by the discussions of the cholecystectomist; and I have had my views of surgical pathology much distorted in viewing the gall-bladders removed and those which they left to drainage; and my conclusions were finally forced upon this paradoxical statement, viz., the gall-bladders which were most in trouble were turned over to drainage, while those easily accessible and little diseased were removed. I want to say that this principle will never work in abdominal surgery and it has failed here. To remove the gall-bladders that are easily accessible and leave those that show most evidences of disease, of course mitigates against the good results of cholecystostomy as the very ill and unfavorable cases are placed in the columns of cholecystostomy. Our cholecystectomists have not been sufficiently generous in their comparative discussions of these two precedures or they would have been uniformly referred to this very strong point in the relative mortalities of the two procedures.

Were I a warm advocate of cholecystectomy I certainly would insist upon removing the gall-bladder that was most pathological even if it were the more difficult. For a number of years in the Joseph Price Hospital I have been contending that the most nearly ideal results have been obtained by thorough drainage of the big, acutely infected or gangrenous gall-bladders, in spite of the fact that popular teaching strongly insisted upon removal of them. I know of no acute infectious condition in which we have gotten more brilliant permanent results.

I am again pleased to see during the past year a number of good discussions advocating drainage of these acutely inflamed gall-bladders by men who a few years ago removed them with an unnecessarily high mortality. Now, if the big, green, gangrenous gall-bladder can be drained with such brilliant results, and our experience leaves absolutely no doubt regarding this point, just what type of pathological gall-bladder other than the malignant is it necessary to remove?

For the cholecystectomist to fall back on the bacteriologist and say that because infecting bacteria

*From the clinic of the Joseph Price Hospital.

are found in cultures from the gall-bladder wall therefore its removal is necessary, is begging the question. How many areas in the entire system of mucous membrane of the body are devoid of bacteria? We were taught for years that the best way to treat chronic pancreatitis was by drainage of the gall-bladder; now the gall-bladder is held as an infecting cause in chronic pancreatitis and its removal is advocated. We are taught by the cholecystectomist that the gall-bladder does not function after surgical drainage, I have many times seen this denied. Years ago I prophesied in literature that numerous papers would come forth on the surgery of the bile ducts following so uniform removal of the gall-bladder; the reader may be the judge whether such has come to pass. That the gall-bladder has an important function is evidenced by the hypertrophy of the bile ducts after its removal, and until this takes place as a compensating function the patient has not properly convalesced. The very fact that after removal of the gall-bladder there is uniformly a compensating hypertrophy of the bile ducts, points clearly to the function of the gall-bladder. An operation may be popularized and forced upon the profession by a few conspicuous teachers provided its primary mortality is not too high and Nature's means of compensation takes care of questionable surgical judgment.

Surgery is legion in its discussion of injuries to the bile ducts incident to the removal of the gall-bladder, a complication most trying to meet and exacting a mortality greater than all of the causes of death rate in cholecystostomy. I am at a loss to know what to do with the great number of patients who come to me for surgical relief following removal of the gall-bladder; they are often more uncomfortable than before cholecystectomy was done. When I send these patients back to the original operator they too often meet with no more satisfaction than they got from me. To simply open up and attempt breaking of adhesions in these cases invites too often more numerous adhesions; and, further, the region is very inaccessible after removal of the gall-bladder. In over twenty years experience in the Joseph Price Hospital where over ninety-eight per cent. of the gall-bladders have been drained, the mortality has been about one per cent. and less than two per cent. of the cases have returned for any further surgery of the gall-bladder. I appreciate that our cases requiring re-operations often go elsewhere. I have record of three cases operated upon for gall-bladder removal which I had drained. In two of these cases I had said before operation that it was doubtful whether either drainage or removal of the gall-bladder would be of any service, as I felt the patients were suffering from a diffuse septic cholangitis probably involving the remote or peripheral bile ducts or a septic hepatitis. These two patients who went elsewhere for gall-bladder removal following my drainage both died. The third case I was told, had a gall stone removed sometime after my drainage of the gall-bladder. Doubtless there are others I know nothing about, but drainage of the gall-bladder has been one of the most satisfactory procedures I do.

The nature of the drainage has much or all to do with the failures of cholecystostomy. It is impossible to drain a gall-bladder thoroughly with tubal drainage. I have called attention to the principle involved in the drainage of any septic cavity by the drainage tube. If the reader will fancy a circle two inches in diameter and within that a smaller one of say half-inch diameter, and then imagine the larger circle to collapse in irregular folds until its arcs come in contact with the smaller circle, he will have forcibly demonstrated the principles involved in drainage of the gall-bladder by any kind of tubal drainage. The walls of the gall-bladder collapse in irregular folds about the drainage tube, forming enclosing pockets of infectious material which, of course, continues the gall-bladder infection. Many procedures in surgery fail, not on account of the principle applied, but on account of the method through which that principle is applied. If the surgeon will throw away his rubber tube and pack all these infected gall-bladders with gauze drains and permit them to remain at least a week before he begins to remove them, he will be rewarded by brilliant results. The principle of ballooning or distending the septic cavity by gauze should be well known, as it is used in abscess cavities throughout the application of general surgery, and it was this principle of distending the wound cavities with gauze with the interspersed small rubber tubes which had much to do with the success of the Carrel-Dakin method of treating septic wounds.

The darkest day that septic and pus-forming lesions of the abdominal cavity experienced was the hour gauze drainage was abandoned for tubal drainage. You cannot effectually drain any extensive irregular septic cavity with any kind of tubal drainage. Thousands die whose death certificates must be signed by the rubber drainage tube. The principles involved in surgical pathology never change; it is our misinterpretation of them which goes astray.

The cholecystectomist is on the stand, he must answer some questions. He must not contend that there is not a marked difference in the mortalities of

cholecystostomy and cholecystectomy. He must not contend that the gall-bladder has not a distinct function which is indicated by hypertrophy of the bile ducts after removal of the gall-bladder and by the excessive number of operations done for duct conditions. He also must be aware of Nature's attempt to restore the gall-bladder by dilatation of the cystic duct as a compensating function following removal of the bladder. He must also admit the formation of stones in the ducts after removal of the gall-bladder, just as we occasionally encounter the formation of stones following drainage of the gall-bladder. The comparative ease of the removal of the stone which may have formed following drainage of the gall-bladder is overwhelmingly in favor of this procedure as compared with the removal of the stone in the common duct. The cholecystectomist is most familiar with the trying complication of injury to the ducts incident to his surgery. He most knows the difference in mortality of gall-bladder surgery and surgery of the ducts.

I have already placed the cholecystectomist on the rack of destructive surgical principles when he removes the gall-bladder that gives little evidence of disease and is easily removed, and turns over to cholesystostomy the excessively diseased gall-bladder because it is difficult to remove on account of its inaccessibility, or of an over-fleshy, or a very ill patient, or adhesions, etc. Although I am at present on the list of cholecystostomists, I would have more sympathy for the surgical principles of the cholecystectomist if he did not pick his cases but removed all the gall-bladders. It would then seem to me that he had the courage and force of his convictions.

SUTURE OR DRAINAGE OF THE COMMON DUCT.

After the removal of a stone from the common duct, provided bile drainage through the ampulla or the gall-bladder is assured, the entire duct lumen may be closed with fine chromic gut, just as wounds of the intestine are closed. On the other hand, drainage of the common duct is required:

(1) If there has been a stone in the ampulla;

(2) If the duct mucosa has been so injured as to cause hemorrhage;

(3) If there is a probability of post-operative closure of the duct by swelling.

In cases in which drainage of the duct is not required and the duct is sutured, a drain is placed near, but not against the line of suture.—GEORGE W. CRILE in the *N. Y. State Journal of Medicine.*

INTUSSUSCEPTION.

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Intussusception of the small and of the large intestine has probably prevailed since human beings abandoned the method of locomotion in vogue among their reputed ancestors and assumed the erect posture. Search of available literature fails to disclose any authentic records of intussusception among the lower animals; even those temporarily assuming sitting or standing attitudes seem immune to it.

Contrary to the views expressed by older observers, intussusception cannot be legitimately classified as a disease, *sui generis,* insomuch as the intestine is more often than otherwise perfectly normal when invagination occurs. It is probable, however, that previously diseased or devitalized viscera may be more susceptible to invagination than those that are normal, but there is no information to substantiate this assertion.

Although no age enjoys complete exemption, intussusception is most commonly noted during infancy and early childhood, and rarely in adolescent and adult life. It is most common during the first decade (50%), the greatest frequency being in infants less than one year old (75%), the percentage gradually decreasing as age advances. It is interesting to note, in passing, that intussusception is said to be responsible for about 35% of complete obstructions of the intestinal lumen.

Etiology. Despite years of clinical and necroscopic investigations the actual determining factor of intussusception remains in obscurity. There are, however, certain presumed exciting or predisposing causes which deserve brief review.

It is known that at birth the lumina of large and small intestines are approximately equal in diameter, whereas the former becomes three or four times greater than the latter in childhood or early adolescence. As already stated, in about 75% of instances intussusception occurs during the first year of life, and the anatomic peculiarity mentioned may exert some influence as a predisposing or exciting factor.

Another anatomic fact must also be considered, viz., the inordinate length of the mesentery of the terminal ileal segment in infancy. This permits of an unusual range of intestinal mobility which probably favors invagination under circumstances to be later mentioned.

Dietetic irregularities with resulting enteritis and ileocolitis, appendiceal abnormalities, Meckel's diverticula, intestinal ulcerations, neoplasms involving

the mesentery or the intestinal walls, etc., have been accused as contributing causes.

Probably the most important exciting factors are: excessive peristalsis and unusual contractile activity of the intestinal musculature, both of which may be due to irritation superinduced by causes which may or may not be possible of demonstration.

"When the process of invagination has once started, and particularly when it exceeds physiologic limits, it is enforced and reinforced by the same factors that initiated it. It is quite possible that the head of the invagination, after it becomes tightly wedged into the sheath, constitutes the primary irritant which causes further spasmodic constriction of portions of the intestine situated above it, or causes violent peristaltic movements of this portion of the intestine, which, in its turn, carries the incarcerated head downward just as it would propel any other constituent of the intestinal contents onward."

Types. Intussusception may occur in any portion of the intestinal tract, from the duodenum to the rectum, and in character it may be either single or multiple, reducible or irreducible. The most frequent site of origin is at the ileocecal junction. "In the vast majority of cases, the beginning invagination is located at or near the ileocecal valve, and the degree of telescoping of the intestine may vary from a few inches to several feet. At times the large intestine is invaginated throughout its entirety and one easily feels the apex of the intussusception by the tip of the examining finger in the rectum. Usually the intussusception is single, but it may be multiple." The terminal ileal segment is primarily invaginated through the ileocecal valve, and if not promptly spontaneously or artifically reduced may finally involve the cecum, ascending, transverse and even the descending colonic segments. The types known as ileo-ileal, ileo-colic, colo-colic, and various other anatomic combinations have been observed, but being comparatively rare they will not be specifically discussed. The greater prevalence of the ileocecal type may be explained, at least in part, upon the basis of the anatomical peculiarities already described.

Histology. It is known that any part of the intestinal wall may be affected, but one portion usually suffers more than others; the stress of the affection seems to fall most often upon the submucous tissue and upon the circular muscle. The mucosa may also be seriously injured; the longitudinal muscle layers and the serosa are least affected.

The earliest histological changes are correlated with an effusion of blood, but the amount of extravasation varies greatly,—at one time it may be so slight as hardly to displace the tissues, at another so considerable as to utterly destroy them. The site of the extravasation also varies; it may be in the mucosa,—and it seems this occurs in most acute cases; it is usually in the submucosa, but it may be in the muscular layers of the serosa. The extravasation is followed by inflammatory changes, in which the submucosa and the circular layer of muscle are chiefly involved. These changes terminate in hyperplasia of the connective tissue leading to sclerosis, in a tryptic (pancreatic) digestion, with disappearance of every cellular element in the intestinal wall, and the conversion of its connective tissue into rectulin, in diffuse suppuration or in sloughing of the inflamed intestine, "which is then separated and cast off by the ordinary process of ulceration." (Power.)

Pathology. The pathology of invaginated intestinal segments has also been carefully studied microscopically and otherwise. Hess relates the history of a child of four months who was subjected to celiotomy eighteen hours after onset of the first symptoms of invagination. Death later occurred from bronchopneumonia, and fortunately a necropsy was permitted. The intussusception was of the usual type (ileocecal) which is considered most favorable for operative intervention. The mucosa and submucosa seemed to have borne the brunt of the destructive process in both ileum and colon. The mucosa showed areas of marked infiltration, destruction of glandular elements and several areas of ulceration extending downward to the submucosa and occasionally involving the muscular layer of the intestine. The submucous layer was the site of hemorrhagic infiltration, separation of its constituent fibers, with resultant thickening of the entire coat—in places being four to eight times its normal thickness. The site of round cell infiltration was most marked beneath the ulcerated mucosal areas. The lymphadenoid tissue forming the solitary follicles and Peyer's patches was greatly increased. The circular and longitudinal muscular layers, as well as the serous coats, had undergone little change.

While, as already stated, the intestine is usually non-pathological when invagination occurs, there may be rare exceptions to this rule. However, it is known that secondary pathological changes which may endanger or even destroy life promptly supervene. Chief among these are: congestion, inflammatory infiltration of the involved areas, swelling, edema and consequent constriction, interference with the blood supply, finally tissue necrosis and gangrene.

Symptoms. Unfortunately the clinical manifesta-

tions induced by intestinal invagination are not always typical or characteristic during the early stages of the affection. The symptoms to be described, in the order of their frequency, may be slight or marked, constant or inconstant, continuous or intermittent, and some may be present early while others may be entirely absent until late in the course of the affection.

(1) The initial symptom is ordinarily sudden, severe, cramp-like, indefinitely situated, abdominal pain, which may later become distinctly localized in the involved area, attended by tenesmus, straining and the expulsion of small quantities of feces and flatus at intervals. There is usually a history of normal existence prior to the sudden onset of abdominal discomfort.

(2) Nausea and vomiting may be present during the initial attack of pain or be delayed for several hours. When vomiting supervenes it usually persists; it may become projectile in type and fecal in character, depending largely upon the site of intestinal constriction.

(3) After expulsion by natural (or removal by artificial) measures of the intestinal contents distal to the site of obstruction, obviously no further feces can appear at the rectal outlet and constipation exists. However, constipation early in the attack must not be misinterpreted. It is an important symptom of other lesions.

(4) A palpable abdominal tumor is significant when present, but the typical "sausage-shaped" mass described in the majority of textbooks is usually conspicuous by its absence. The size and conformation of the mass when such is present must depend largely upon the site and extent of the invagination, hence the designation "sausage-shaped" should be eliminated from the nomenclature. Moreover, a tumor may be present due to intussusception and be impossible of palpation because of its anatomic situation. This fact has been repeatedly shown by operation and necropsy.

(5) The expulsion from the rectal outlet of blood-stained mucus, or "mucus streaked with blood," during paroxysms of pain and tenesmus is important evidence, but unfortunately, and for obvious reasons, is a symptom seldom noted until invagination has existed for hours or even days. The appearance of blood and mucus in the dejecta of infants, in the absence of other indicative symptoms, must not be given too much credence as a sign of intussusception. There are many other lesions which may produce "bloody stools." However, when present in conjunction with other symptoms it is almost pathognomonic of intestinal invagination.

(6) Instances have been recorded in which the invaginated intestinal segments finally traversed the entire distance from the ileocecal junction to the rectum and either protruded therefrom or could be felt with the examining finger. Fortunately such extreme invaginations are rare and for the most part represent neglected cases which are almost uniformly fatal.

(7) In the majority of instances shortly after the onset of symptoms the patient exhibits evidence of prostration and exhaustion from inability to retain nourishment, and shock in varying degrees is also commonly present.

Diagnosis. As must be apparent from the foregoing, the early clinical diagnosis of intussusception is not always easy of accomplishment based upon any one symptom exhibited by the patient; but there should be little or no difficulty in arriving at a definite conclusion when the majority of the clinical signs enumerated are present.

It is well-known that undescended testicle, appendicitis, thrombosis of the mesenteric artery, and less frequently the intra-abdominal lesions of other types may induce pain, vomiting, etc. The location of the abdominal discomfort may vary but slightly in any of the lesions mentioned; likewise pain may be either constant or paroxysmal in character. However, in intussusception the attack is sudden and of greater severity during its early stages, and prostration is out of proportion to other manifestations present.

The early appearance of intra-abdominal tumor is unlikely in appendicitis, undescended testicle, thrombosis, poisoning and other lesions which may produce pain. On the contrary, a more or less distinctly palpable mass is present in the majority (about 90%) of cases of intestinal invagination within a few hours after the onset of symptoms. If there is sufficient rigidity to render palpation unsatisfactory, it is advisable to administer a few whiffs of ether; this will cause muscular relaxation. In this manner the mass may be made readily palpable, whereas otherwise it would have been impossible. In differentiating between invagination and appendicitis this will oftentimes be of great assistance. If the condition of the patient is too desperate for preliminary examination to be made under ether, it is then advisable to immerse the child in a tub of warm water and palpate the abdomen beneath the water. This will usually cause considerable relaxation of the abdominal muscles.

Pain, nausea, vomiting, tumor, dejecta of blood-stained mucous, early prostration, constipation and rarely slight fever are the principal diagnostic signs.

The site of constriction and consequent obstruction may be easily determined by roentgen-ray and fluoroscopic methods of investigation. The importance of the roentgen-ray can hardly be overestimated as a diagnostic measure in every type of intra-abdominal lesions, whether the patient be an infant or an adult.

Treatment. Medicinal: It must be obvious that there is no drug which internally administered can have the least effect in the reduction of an invaginated intestine. In other words, there is no medical treatment of intussusception. Granting that the diagnosis has been definitely established, the administration of laxative and purgative drugs can be productive only of harm; the excessive peristalsis and straining induced increase the area of invagination and thus greatly enhance the clinical dangers. However, to assuage pain and promote quietude sedatives are permissible and may be administered as required; all other drugs are contraindicated and their routine use should be condemned.

Mechanical: When, many years ago, it became apparent there was no effective medicinal treatment of intussusception, and that spontaneous reduction was exceptional, other means were diligently sought. It was then that mechanical methods were first employed. It was thought invagination might be reduced by agencies externally applied. These consisted of kneading, manipulating and massaging the presumed involved intestinal area by the operator's hands. The introduction of air or water (or both) into the invaginated portion of the intestine through the rectum and colon was also advocated, the patient during the procedure being placed in a semi-inverted posture. Complete inversion and gentle "shaking" of the individual to reduce the invagination was at one time recommended. The irrigation procedure is well-known today under the designation "the aerohydrostatic method."

Wonderful to relate, the foregoing methods of treatment early applied were apparently successful in a small percentage of cases. Obviously, however, failure attended the procedures when instituted late in the course of the affection, i. e., after adhesions had formed between intussusceptum and intussuscipiens, in certain types which were irreducible from the beginning, and where invagination was extensive or existed in an inaccessible anatomic region. In many instances reduction was not accomplished, but the patient recovered after separation and extrusion of the intussusception by the sloughing process. Spontaneous recovery by similar process was sometimes noted in untreated cases.

Strange as the observation may appear, the foregoing described methods of treatment are still advocated and practiced to greater or lesser extent in certain quarters, notwithstanding the unfortunate fact that the mortality under such management remains nearly 100%. Quite frequently, even in this presumably enlightened surgical era, unwise and unwarranted statements similar to the following appear in medico-surgical literature: Not all pediatricians and surgeons favor immediate operation in the treatment of intussusception; there are those who advocate aerohydrostatic and manual methods even in long-standing cases. Porter recommends the irrigation plan, but sees no reason why the abdomen should not be opened and the procedure executed under the direct vision of the surgeon. Hess says it is before decided pathological changes have occurred in the intestine that one may hope to obtain favorable results by irrigation or other mechanical methods of reduction. Griffiths advises non-surgical reduction where invagination has persisted only one or two days. Apfel mentions reduction by water pressure of an intussusception that had existed for six days. Daws reduced an acute invagination by enema and external manipulation.

When confronted with an undoubted case of intussusception, to temporize with medicinal and mechanical methods, even for a few hours, in the hope of affecting reduction is, in my opinion, merely courting disaster and inviting a fatal issue. The pertinent facts must not be permitted to pass unobserved: that spontaneous reduction is practically a negligible quantity, and that such case records appearing in the older literature should be questioned; that in intra-abdominal lesions of every type diagnostic errors are not impossible without the confirmatory evidence afforded by careful roentgen-ray investigation, exploratory celiotomy, or autopsy. The opinion is further ventured that where spontaneous reduction has been reported, without separation and expulsion of the intussuscepted mass, a mistake was made in the clinical diagnosis.

Operative: Intussusception is primarily and essentially a surgical affection and must be so considered. It is an exploded theoretical assumption that children are unfavorable subjects for radical operation.

If delay in invoking surgery has been inevitable, and in consequence of adhesions and invagination cannot be reduced without inflicting irreparable intestinal damage, or if because of prolonged strangulation the intestine has become devitalized and exhibits signs of beginning necrosis, then resection of the involved area should be immediately performed as a life-saving measure. The technic of resection, and manner of re-uniting the divided intestinal seg-

ments, must be left to the judgment of the individual surgeon. The method employed must necessarily be modified to meet the indications.

The surgical treatment of intestinal invagination represents nothing new. It may not be generally known that Paul Barbette, in 1676, advised opening the abdomen in obstinate volvulus and intussusception; that Nucke had celiotomy performed successfully upon a patient for relief of intussusception a few years later; that both operative and mechanical treatment were probably employed centuries prior to the date mentioned.

The location of the incision for intussusception will depend somewhat upon the site of the lesion. Some surgeons prefer a mid-line incision regardless of the site of invagination; others claim that, as the lesion is usually in the ileocecal area, incision should always be made there. As a matter of fact, location of the incision is of little importance, provided it be made of sufficient length to enable the surgeon to complete the required steps with the least possible delay.

The greatest degree of gentleness in manipulation is one of the prerequisites to success of the operation; and the importance of complete hemostasis and asepsis must be constantly borne in mind; however, reduction must be accomplished as speedily as consistent with safety. Where disinvagination is feasible, and this will be found true in the majority of instances if operative treatment be not too long delayed, separation of the invaginated intestinal segments should be accomplished from below upward by the process known as "milking" which is familiar to everyone.

It is known that recurrence of invagination is not infrequent following reduction and that as a rule fatality ensues. As a preventive measure, therefore, it is advisable in every instance to anchor the peritoneal surface to the disinvaginated intestinal segment to the parietal peritoneum. Or, if preferred, in the ileocecal type the plan devised by Cubbins may be followed, i. e., the ileum is brought parallel to the ascending colon and united thereto with three to five catgut sutures. If thought necessary the cecum may be fixed in the iliac fossa with another suture. "The fact that the two bowels are parallel and cannot intussuscept will be at once evident."

Silleck states that intussusception, especially in infancy, is attended with appalling mortality, according to some authors as high as 73%. He believes the results are directly dependent upon duration of the invagination prior to the institution of surgical treatment. Operations within the first twenty-four hours after onset show over 95% recoveries in the hands of experienced surgeons.

The following statistics given by Silleck, from the New York Post-Graduate Hospital, for the last five years, are of considerable interest in this connection. Thirty-four patients were operated upon for intussusception by six surgeons; the age of those under one year averaged six and a half months; of those over one year, the average was two and a half years, the eldest child being six. As to sex, 74% occurred in males. It is also interesting to note what the figures show as to mortality in relation to preoperative duration of the affection.

Duration	Number Cases.	Cured.	Died.
Four days	1	0	1
Three days	1	0	1
Two days	9	2	7
One day	12	9	3
Less than 24 hours...	6	5	1

In four instances no mention was made of duration. Vomiting was present in 77%, bloody mucus in 97%. Mass felt through abdominal wall in sixteen cases; by rectum in seven. In five no mass was felt; in thirteen no reference was made thereto on the chart. As to location of the invagination: 12% were limited to the small intestine; remaining 88% at or near ileocecal valve involving both small and large intestine. In 71% the intussusception was reducible. Intestinal resection performed in 29%; of these 23% were gangrenous and 6% irreducible. Of the resected cases 76% died and 24% recovered; average amount of intestine resected eight inches. The appendix was removed in 32% of the cases. Total patients operated upon 34; cured 59%; died 41%.

In the series there was one definite recurrence after six months. In one case the intestine was perforated during attempt at reduction. Lobar pneumonia was a complication in one case; one patient died from hemorrhage following an infected wound; one died from general peritonitis; another from inanition, no surgical cause being found; the remaider were profoundly toxic and failed to rally. (Silleck.)

Thirty-six cases of intussusception are analyzed by Edington. In 35 in which the result was recorded there were 21 recoveries and 14 deaths. Of 24 patients subjected to operation during the first day, 16 recovered; of 9 operated upon after the first day, only 3 recovered. Three deaths occurred shortly after operation apparently from shock; one patient died from gastro-enteritis the twenty-second day; in the remainder death occurred within twelve to fifty-five hours and was usually preceded by rapid rise of temperature with evidence of toxemia. The relationship of fatality to anatomic type was: ileoce-

cal, seven cases, two deaths; ceco-ileocecal, six cases, two deaths; colo-colic, five cases, no deaths; ileo-colic, four cases, two deaths; ileo-ileal, four cases, four deaths; ileo-colic-ileocecal, three cases, two deaths; ileo-ileal-ileo-colic, three cases, two deaths; ileo-ileal-ileo-colic-ilececal, three cases, no deaths; type not recorded, one case, no death.

In 23 consecutive cases analyzed by MacAuley, 20 patients were less than one year old; 4 died, mortality 17.3%; excluding one gangrenous case the mortality was 14%. One child died of bronchopneumonia; 3 succumbed to shock within twenty-four hours after operation; 1 of the latter had anesthetic collapse during operation requiring prolonged artificial respiration; another was practically moribund (gangrenous) when operated upon. Type of intussusception: enterocolic, twenty cases (ileocecal and ileo-ileocecal); colic, one case; enteric, one case; unknown, one case.

SUMMARY.

(1) Intussusception is noted with greatest frequency in children less than one year old, the incidence of the abnormal occurrence gradually decreasing as age advances.

(2) It is not a disease, *per se*, the intestine ordinarily being normal when invagination begins, later becoming pathological because of strangulation and consequent interference with its blood supply.

(3) The actual determining etiological factor of intussusception appears unknown, but there are several anatomic peculiarities incident to infantile life which may be operative as predisposing or contributing causes.

(4) The early manifestations of intussusception being sometimes atypical, accurate clinical diagnosis cannot always be made and resort must be had to roentgen-ray and fluoroscopic methods, the importance of which as diagnostic measures can hardly be overestimated.

(5) All medical and so-called mechanical methods suggested in the treatment of intestinal invagination are not only uncertain in effect, but entail unwarranted delay, and to employ them is merely to court disaster and invite a fatal termination.

(6) The theory has long since been exploded that young children are invariably unfavorable subjects for operative surgery, and the general practitioner who is first to be consulted in cases of intestinal invagination should immediately seek competent surgical assistance.

(7) The tremendously and unreasonably high mortality of intussusception can be materially reduced by early diagnosis and prompt application of rational surgical principles.

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TRAUMATIC RUPTURE OF THE SPLEEN. REPORT OF A CASE.

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Rupture of the spleen may be traumatic or spontaneous, the former the result of trauma upon a healthy organ, the latter involving an organ already the seat of disease often of an inflammatory nature, be it malarial, typhoidal or tuberculous. A spleen that has undergone pathologic change is more easily ruptured because of its increased size or because of its change in consistency. Many cases of rupture of supposedly normal spleens have been reported, but upon examination after removal they were found to be pathological in that they were increased in size or changed in structure.

Subcutaneous traumatic rupture of the normal spleen is a rather unusual occurrence.

Rupture of the spleen follows accidents not unlike that which would cause a rupture of the kidney, but in the majority of instances the kidney will rupture and the spleen escape. The passage over the body of wagon wheels, crushes beneath heavy organs, automobiles and railroad accidents, the kick of horses and man, falling upon angular objects or falling from a distance may be numbered among the more common possible causes. With the rupture of the spleen one often finds fracture of one or more ribs.

There is no definite clinical picture of rupture of the spleen. The symptoms presented could be accounted for by tears of the liver, pancreas or mesentery and hemothorax or mesenteric embolus, etc.

The usual findings are pain in upper left abdomen often increasing in intensity, tenderness and muscular rigidity over the lower chest and upper abdomen, some difficulty in breathing, pain referred to the left chest and at times to the left shoulder. In case of hypertrophied spleen a bulging or mass may be made out in the left side. Finsterer says that injury of the liver is followed by bradycardia and injury of the spleen by increased frequency of the

pulse. Hauke noted no material change in the frequency or quality of the pulse in his series of cases. The signs and symptoms being those of a severe injury to some abdominal organ are sufficient to justify an exploratory operation.

Ruptured spleen can be treated only as a surgical condition and since the prognosis depends largely upon early operation, expectant medical treatment is not advisable.

Eccles and Freer have recently reported a case in which a young man suffered a rupture of the spleen during a foot-ball game. The spleen was removed and ten years later another operation was performed for a hernia resulting from the first operation. After opening the abdomen and exploring the left hypochondriac region, much to the astonishment of all, an apparently normal looking spleen was seen in the usual position. It had a definite pedicle in which could be felt pulsating vessels. The shape, size, notch, color and consistency were apparently those of a normal spleen.

The statistics from a large number of autopsies show accessory spleens to be fairly common. They are usually situated near the spleen and may be connected with the mother-organ by bridges of splenic tissue or only by a portion of the capsule. They are generally wholly isolated, however, and are situated in the gastro-splenic omentum, great omentum, or transverse mesocolon. They vary in size from pinpoints to several centimeters in diameter.

At a recent autopsy, I found an accessory spleen situated at the hilus in the supporting tissue of the bloodvessels and not attached to the spleen. It was 3½ centimeters in diameter.

It is reasonable to assume that the spleen found by Eccles and Freer at a secondary operation after splenectomy was an hypertrophied accessory spleen. I am of the opinion also that the good results following a great many splenectomies are due to the function of the spleen being carried on by the hypertrophy of one or more accessory spleens.

The mortality for all cases of splenectomy up to 1919 was about 28.8%. But it is evident that the mortality will vary and will depend upon the extent of the injuries, number of organs involved, the amount of blood lost, timeliness of operation and facilities for transfusions.

Haute has used the blood found in the abdomen for transfusion, giving it by the citrate method and thinks he has saved many lives in this way.

CASE REPORT.

J. P. L., white, male, age 20 years, college student, entered the Elizabeth Hospital on November 12, 1921, complaining of pain in the upper left abdomen. Four or five hours previously he was struck in the left side by the knee of an opponent in a foot-ball game. The pain was not very severe at first and he continued to play for several minutes. Suddenly he "fell out" with a sensation of numbness over all extremities. There was considerable pain in the upper left abdomen and costo-vertebral angle. He was seen by the college physician, who thought the patient had received some injury to his spleen and immediately brought him to the hospital. As they were leaving for the hospital, the patient vomited once. He was given ¼ gr. of morphine sulphate on departure from the college.

Upon arrival at the hospital, after a drive of thirty miles by automobile, he felt fairly comfortable and asked to be allowed to walk to the bathroom. He was a well nourished, muscular young man with mucous membranes of normal color. There was considerable tenderness over the upper left abdomen with rather marked rigidity, rendering palpation unsatisfactory. Temperature normal, pulse 78, respiration 24. Urinalysis showed trace of albumen, a few hyaline and granular casts and a considerable number of red blood cells. In view of his increased comfort any operative procedure was not deemed necessary at this time and it was decided that he should be kept under observation.

Except for vomiting once, he spent a fairly comfortable night and felt considerably better the following morning. For three days he did well only complaining of some pain in the upper abdomen at times. On the night of November 15th, the pain became somewhat worse about 9 o'clock and caused him to be rather restless, at about 3:45 A. M. he became much worse. When seen he was extremely pale with rapid pulse and other signs of shock and internal hemorrhage. He was given 500 cc. of saline solution intravenously at 7 A. M. and was put under the influence of morphine. At 10 A. M. he was given 400 cc. of blood by the citrate method. Following the saline and blood transfusions, he rallied to some extent and the pulse became much stronger though remaining rather rapid. An ice cap was applied almost continuously to the seat of injury. Patient's condition seemed somewhat better in the evening and the following night and day were spent fairly comfortably.

On November 18th, the condition being somewhat further improved it was deemed advisable not to wait longer for operative procedures. One hour before the time set for operation, 500 cc. of blood were taken from a suitable donor. The operation was begun under local anesthesia, ether being administered when the incision had been made down to the peritoneum. An oblique six inch incision was made one inch below and parallel to the lower left costal margin. Upon exposing the peritoneum a dark fluid could be visualized through it. Upon incising the peritoneum about 2000 cc. of dark blood and several clots were liberated. The spleen was found enlarged and presenting a deep laceration across the body and into the hilus. In view of the size of the laceration and its situation at the site of the large bloodvessels, it was thought best to remove the entire organ rather than to attempt suturing. The vessels were doubly ligated with No. 2 chromic catgut and the abdomen

flushed with saline solution. One piece of rubber tissue was left in the dependent portion of the wound, which was closed with catgut, reinforced with through and through silk-worm gut sutures. A transfusion of 500 cc. of citrated blood was done immediately after the spleen had been removed and the vessels ligated. The spleen measured 22x12x5 centimeters and showed a triangular rupture measuring 6 centimeters at its base and extended from the hilus through the substance to within 2 centimeters of the periphery. The two surfaces were widely separated and filled with a blood clot. The patient stood the operation exceedingly well, there being no signs of shock. There was some bloody drainage from the wound for a few days. The stitches were removed on the seventh day. A back rest was allowed on the thirteenth day. Out of bed on the fifteenth day. Except for some gaseous distension which was relieved by enemata, patient suffered practically no discomfort.

Roentgenogram made on day previous to operation was negative.

Blood Examinations: On November 16th, the day of the hemorrhage, total w. b. c. 20,400, 82% polynuclears, 15% small lymphocytes and 3% large lymphocytes, hemoglobin 55% (Sahli). On November 18th, date of operation, total w. b. c. 13,600, 88% polys, hemoglobin 40%. On November 28th, total r. b. c. 3,760,000, total w. b. c. 12,200, 59% polys, 27% small lymphocytes, 10% large lymphocytes, 3% eosinophiles, 1% basophiles, 74% hemoglobin. On December 3rd, total r. b. c. 4,250,000, total w. b. c. 9,800, 55% polys, 35.5% small lymphocytes, 8% large lymphocytes, 2% eosinophiles, 5% basophiles, 78% hemoglobin. On December 11th, total r. b. c. 4,750,000, total w. b. c. 10,800, 52% polys, 34% small lymphocytes, 14% large lymphocytes, 82% hemoglobin. On February 13th, 1922, total w. b. c. 10,400, 48% polys, 41% small lymphocytes, 9% large lymphocytes, 1% eosinophiles, hemoglobin 86% (Sahli).

The patient was discharged from the hospital on December 11th, after having made an uneventful recovery. Since that time he has resumed his studies in college and has noticed nothing abnormal in his condition.

SUMMARY OF THE CASE.

1. The patient was a male adult.
2. Suffered a blunt blow over lower chest and upper left abdomen with no external evidence of injury.
3. Had some nausea and vomited twice.
4. Slight pain in upper left quadrant for three days and pain increasing about 6 hours before rupture.
5. Rigidity and tenderness over upper left abdomen.
6. Hematuria.
7. No complaint of pain in left shoulder, but when asked if he had it, his answer was in the affirmative.
8. No history of malaria.
9. Rupture occurred 3½ days after the injury was received.
10. Spleen increased somewhat in size, measuring 22x12x5 centimeters.
11. Explanation is that patient received rupture of vessel in substance of spleen with subcapsular hematoma, and that upon effort rupture occurred from the intracapsular tension.
12. Blood examination before operation showed secondary anemia and leucocytosis with an increase of polymorphonuclear neutrophiles. After operation total w. b. c. gradually returned to normal by the fifteenth day. There was a relative increase in both large and small lymphocytes, but more marked with the large than small. There was a 3% eosinophilia present on the tenth day but this had disappeared on the twenty-ninth day.
13. There is no doubt that transfusion of blood is one of the most important therapeutic measures in connection with the operation of splenectomy and the result obtained in this case was probably largely due to this procedure.

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ABDOMINAL SYMPTOMS IN INFLUENZA.

1. Influenza is a protean disease.
2. Abdominal symptoms which would ordinarily indicate the need of an urgent surgical operation are commonly present during influenza, and their frequency is not sufficiently out in the text-books.
3. Conditions requiring an abdominal operation during influenza or its convalescence are exceedingly rare.
4. While in some cases, a differential diagnosis is extremely difficult, the safest procedure in doubtful cases is to adopt an expectant treatment.
5. In case an exploratory operation is decided upon a local anesthetic is advisable.
6. A surgical abdominal lesion and influenza may occasionally coexist.
7. Many unnecessary and harmful operations have been performed during the course of influenza, due to the lack of appreciation of the frequency with which abdominal symptoms occur in influenza.
8. The great majority of cases showing abdominal symptoms have no surgical basis, but are either reflex, or due to some condition which would not be benefited, but rather harmed by a laparotomy.
9. The chest should always be carefully examined before operating for a supposed acute surgical lesion of the abdomen.—THOMAS HUBBARD RUSSELL in the *New York Medical Journal.*

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WALTER M. BRICKNER, B.S., M.D., F.A.C.S., *Editor*
New York City

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CANCER EDUCATION.

Last month the Association for the Control of Cancer held its annual week of educational propaganda during which, by public scientific meetings and by popular lectures throughout the country, it endeavored to preach hopefulness in the curability of cancer, by showing the importance of early diagnosis, by teaching the early symptoms of the commoner varieties of cancer in both sexes, by urging prompt recourse to medical examination upon the first appearance of any suspicious symptom. That cancer is curable surgically in its early stage appears to have been the slogan in this week of popular education. Barring exceptional cases, unfortunately few, it is only in the early stage, at any rate, that cancer is curable by known means. Certainly there have been every year many thousands of cancer deaths that may be laid to ignorance and neglect and that might have been avoided if the disease had been recognized in its incipience. If we are to hope to reduce cancer mortality these popular educational campaigns are of an importance than which no known measure is greater. Indeed, they are bearing fruit. In urban communities, at any rate, there is not only a wholesome fear of cancer, but also an increasing familiarity with some of its early manifestations and an observable increase of resort to medical opinion concerning disturbing signs or symptoms.

Must we not therefore hang our heads in shame when a fatal loss of time in discovering the presence of a malignant growth is due not to the ignorance nor to the delay of the patient but to the neglect of the physician to whose care he has entrusted himself? And does this not, alas, happen far too commonly? How often do physicians accept the patient's diagnosis of "hemorrhoids" and prescribe remedies without even inspecting the anus? Why have so many physicians failed to learn that "hemorrhoids" often are not hemorrhoids at all? Is it diffidence or just rank carelessness that so many are willing to treat piles (?) without seeing them? Why so commonly are visible hemorrhoids accepted as the cause of bleeding wihout inserting the finger into the rectum to determine the possible presence of something more serious? How often is the escape of mucus with the stools long treated as a manifestation of "colitis" without an endoscopic examination of the rectum and sigmoid, indeed, even without a digital investigation? How often is a gradually developing and increasing constipation treated with laxatives without arousing the suspicion of a neoplastic obstruction? How often are persistent gastric symptoms treated medicinally as "indigestion" until alarming loss of flesh impels the thorough diagnostic examinations that might have saved life if resorted to earlier? How often is an unusual vaginal discharge treated with douches without an inspection; how often is irregular bleeding from the vagina attributed to "change of life" without sufficient examination, gross and microscopic? How often is hematuria treated with drugs to the neglect of cystoscopic investigation? How often is epithelioma of tongue or lip treated without a biopsy as a chancre or gumma because the Wassermann test shows that the patient is a syphilitic? And even in that common field of cancer development, the female breast, where inspection and palpation alone are notoriously inadequate to diagnosis, how often is a tumor, especially in the young virgin, lightly dismissed as benign until extension into the axillary nodes carries it to, if not beyond, the borderline of incurability?

Perfection in diagnosis is not attainable by any of us. In dealing with human flesh mistakes will be made by the best of us. But diagnostic mistakes are inexcusable when they arise from failure to submit the patient to reasonably thorough examination, whether that failure be because of hurry and over-

work, of diffidence, of a willingness to "take a chance" or of plain carelessness. Education of the public is important, indeed, but it is not enough. Many of the medical profession itself need education by constant preaching, not, to be sure, in the elementary facts that we are disseminating among the laity, but in the vital necessity for bearing these facts constantly in mind, for putting them into daily practice, for thinking always of a malignant growth as a possible cause of symptoms and for insisting upon an examination sufficiently adequate to discover it or to exclude its probability.

URETERAL CONSTRICTIONS.

Of more than passing interest, it seems to us, is the article in this issue of the JOURNAL by Charles A. Hill of Pittsburgh, "Obstruction of the Ureter the Most Frequent Predisposing Cause of the Localization of Bacteria in the Pelvis of the Kidney." His ureterographic and bacteriologic studies appear to show "that bacteria will not usually remain in the kidney long enough to produce damage, unless there is some obstruction in the drainage tract, and that often bacteria may be present in the ureteral urine without producing any marked clinical symptoms." While this is but a preliminary report rather than a completed study, the observations appear to be quite striking. They take on added significance in connection with the recent publication of Guy L. Hunner of Baltimore, "Ureteral Stricture: An Important Etiologic Factor in the So-Called Essential Hematurias" (*Journal of the A. M. A.*, November, 1922). Hunner's studies he interprets as demonstrating that ureter strictures are indirectly responsible for hematuria by reason of changes that they produce in the kidney, and his therapeutic experience with his series of cases suggests that dilatation of ureter strictures and care of focal infections (e. g., in the tonsils) will be the future treatment for most of the so-called essential hematurias. These two papers are complementary and mutually supportive. They ought to be studied together and carefully, for they suggest many interesting possibilities both in renal pathology and in urologic therapy. Pyelo-ureterography and other forms of cystoscopic study have taught us much concerning the morphology, the genesis and the pathologic consequences of ureteral abnormalities, congenital and acquired. Evidently we are going to learn much more, and almost equally surely we are going to add to our therapeutic methods through further studies in this fascinating field.

Progress in Surgery

Selections from Recent Literature

Traumatic Surgery and Compensation. ARTHUR W. IDE, St. Paul, Minn. *The Journal-Lancet,* November 1, 1922.

Is a surgeon ever justified in amputating a foot simply because of the cost of more conservative treatment? This question will be answered by most people, positively no. But suppose the patient is a young man with several small children. He is on his own financial resources, and his funds are low. How long can he stand it to be out of his job? Unless he can be helped in some way, his time must be short. Most of us, if we were so situated, would insist upon amputation if by this means we were put back to work in a much shorter time. We might be willing to give six months' time for a serviceable foot, but would we be willing to multiply this six months two, three, or four times? There is a vast difference between a clean amputation and short convalescence, and reconstruction work on an injured foot and months of convalescence.

Is it not possible that modern surgery is going to extremes in recommending the saving of tissue? Is it not true that mangled limbs are being left on when an amputation would be better judgment?

It is a serious matter to hold the average man in a hospital for a long period. When a man is first put to bed he chafes under restraint, but as time goes on he becomes more and more reconciled to his lot. He is taught to loaf, and there is great danger that he will learn his lesson too well. It sometimes happens that by the time he is discharged he is a first-class loafer.

Every surgeon of experience has had occasion to regret his conservatism. We can all recall cases where a timely amputation would have saved a life.

Experimental Study of the Healing of Fractures. LEONARD W. ELY, San Francisco. *Archives of Surgery,* November, 1922.

After an ordinary fracture, hemorrhage takes place from the marrow canal under the periosteum. The periosteum is stripped up from the cortex by this hemorrhage and by the fracture itself. Then come the disposition of fibrin, the formation of granulation tissue and the formation of cartilage and fibrocartilage in the space beneath the stripped-up periosteum. Probably the function of the periosteum is only important in the early stages, up to the formation of the cartilaginous callus. The periosteum probably serves to keep the hemorrhage from escaping and the granulation tissue undisturbed. It has no bone-forming function, and bone is not built out of it. The subsequent ossification of the cartilaginous callus is carried out almost entirely, if not exclusively, from the external aspect of the cortex. The internal callus plays no effective part in the union. It is rudimentary when it is present.

Sprains of the Rhomboideus Minor Muscle. JOSEPH P. REPLOGLE, Johnstown, Pa. *Annals of Surgery,* November, 1922.

In 150 cases of shoulder injuries, 25 varieties of lesions in and about the shoulder were revealed, 25% of which were sprains. The author distinguishes one lesion, which he has termed sprain of the rhomboideus minor muscle, as being more frequent than any other traumatic lesion of the shoulder. He states that any muscular movement producing elevation of the lateral angle of the scapula, especially when occurring suddenly, overstretches the interscapular muscles causing sprain of the rhomboideus minor.

The treatment is based on anatomic lines to cause relaxation of the overstretched muscle. The shoulders are thrown back so as to lessen the interscapular space and adhesive straps are applied criss-cross maintaining this position. The arm is placed in a sling and a small pad placed under the adhesive over the point of tenderness to possibly hasten the absorption of the serous effusion at the point of rupture or strain. The above treatment gives immediate relief from aching, and pain on abduction is greatly reduced.

Treatment of Fractured Clavicles. WILLIAM LISLE BELL, Oakland, Calif. *Annals of Surgery*, November, 1922.

Bell describes a plaster casing devised by him for the immobilization of fractured clavicles. It consists of an arm case and a body case applied separately. When the plaster was set, with the body case as a base and a stable foundation, the arm and shoulder joint carrying the outer clavicular fragment was extended (with counter-pressure against the chest case) outward, upward, backward. (It sometimes facilitates placing the outer unit, to cut a gap in the thoracic case over the acromion and inward to the point of fracture, wide enough to allow free elevation of the shoulder, but always leaving a wide shoulder strap of plaster over shoulder and inner fragment at the base of the neck.) When the outer fragment is properly extended, elevated, and placed (inner fragment may be manipulated under the case), a wiped joint of plaster-of-Paris is applied around the gap between the body and arm case and this position scrupulously maintained until the extension ring or wiped joint has thoroughly set. Slight abduction of the arm, 15° to 25°, facilitates placing the circular plaster which covers ample chest, axillary and inner arm padding. The illustrations make the method clearer.

Results of Treatment of Fractured Femurs in Children; With Especial Reference to Bryant's Overhead Traction. W. H. COLE, St. Louis. *Archives of Surgery*, November, 1922.

The author reviews 35 cases, and concludes as follows:

1. The immediate shortening due to overriding of fragments in growing bone tends to correct itself, even though the fragments have healed in overriding position.

2. Alignment of the fragments is more important than the position of the ends of the fragments.

3. Perfect functional results may be obtained from a transverse fracture, with overriding, by using overhead traction.

4. The younger the patient, the more nature compensates for malposition and surgical inefficiency.

5. Overhead traction is more applicable, and will give better results, than any other method in the treatment of fractured femurs in children.

An Inquiry into the Results of the Operative Treatment of Internal Derangement of the Knee-Joint. PHILIP H. MITCHINER, London. *The British Journal of Surgery*, October, 1922.

This is a follow-up inquiry of 225 cases operated upon in St. Thomas's Hospital within the last decade. Replies were received from 134. The following classification was adopted:

Group A.—Loose body in the knee joint (39 cases).

Group B.—Torn or displaced semilunar cartilage (only including those cases where actual evidence of lesion was observed at operation) (125 cases).

Group C.—Hypertrophied synovial fringes (27 cases).

Group D.—No definite intra-articular lesion found (30 cases).

Group E.—Torn crucial ligaments (4 cases).

Two operative routes had been used in opening the knee-joint: (1) A lateral incision over the affected cartilage, either transverse or vertical in direction; (2) A vertical median incision with longitudinal splitting of the patella. Only the former incision was used until 1914.

It would appear that the following conclusions can be drawn from the facts elicited in the examination of this series of cases:

1. That as regards the actual route selected at operation, the transpatellar is the most satisfactory in all respects.

2. That no method of splinting is necessary or advisable to secure fixation of the knee after operation; early movement, combined with electrotherapeutic measures, are beneficial in promoting early absorption of effusions.

3. That the full benefit of the operation is not to be expected for from two and a half to three years after its performance.

4. That those cases were a definite lesion of the intra-articular structure is present give far more satisfactory results (76.6 per cent in cases of damage to the semilunar cartilage, and 60.9 per cent in those of loose body) after operation than where no definite lesion can be found (37.7 per cent with synovial fringes, and only 27.7 per cent where no lesion is seen at operation).

5. That when nothing abnormal is found on the joint being opened, the best course to adopt is to close the joint without interfering with the intra-articular structures.

On reviewing the whole of the facts set forth in the foregoing article, it would seem that operative interference in cases of internal derangement of the knee is justifiable, if not indeed desirable, in all cases where a diagnosis of a definite lesion of any of the intra-articular structures can be hazarded with any degree of certainty, and where the consequent disability is sufficient to prevent the patients carrying out efficiently their daily avocation.

The Use of Large Reverdin Grafts in the Healing of Chronic Osteomyelitis. MONT R. REID, Cincinnati, Ohio. *Bulletin of the Johns Hopkins Hospital*, November, 1922.

The purpose of this paper is to introduce another method of treating certain bone cavities, remaining after operations for chronic osteomyelitis. It consists essentially of epithelializing the walls of bone cavities by the use of large Reverdin or pinch grafts. (Lord, in 1902, employed a Thiersch graft in a similar way.)

The bone cavity is treated with Dakin's solution until it becomes lined with clean firm granulations. Without the use of Dakin's or some other antiseptic solution the granulation tissue becomes edematous or "sea-weedy," and forms an unhealthy base for the growth of grafts. Two hours after the last irrigation with Dakin's solution large thick pinch grafts, half a centimeter in diameter are placed closely together upon the surface of the cavity. The grafted wound is then exposed to the air for from six to eight hours. This short drying period serves to fix the grafts firmly to the granulation tissue. The grafts are then covered and held in place with a single layer of gauze which is firmly secured to the normal skin so that the moistening and changing of saline compresses during the next two days will not displace the grafts. After two days the grafts have taken and the use of Dakin's solution instead of salt solution is begun. This is applied by laying wet compresses directly against the wound (the thin layer of protecting gauze having been removed) every two hours during the day and every four hours at night. After about five days the Dakin's solution is discontinued and the wound is dressed with rubber "protective" or old linen. Invariably the grafts grow quickly and cover the granulation tissue with epithelium in from ten days to two weeks. Should the granulations become high (usually from the edema of infection) caustics should not be used; Dakin's solution reapplied for one or two days will reduce the swollen granulations to the level of the grafts, and will not injure the growth of new skin.

The epithelial covering which results from the use of pinch-grafts is thicker and more durable than that obtained by the use of Thiersch grafts. In deep cavities there is always a tendency toward the formation of moisture, and in bone cavities the thick pinch-grafts are tough enough to withstand the tendency to maceration, whereas Thiersch grafts often appear to melt away after taking.

Another factor in favor of the use of pinch-grafts is the certainty of their taking. On a surface properly prepared with Dakin's solution practically every graft will take. Thiersch grafts, on the other hand, do not grow as constantly, for the impossibility of sterilizing completely a granulating surface will often result in the accumulation of pus which may lift these grafts from their base.

A Clinical Study of Phrenic Shoulder-Pain; With Special Bearing on the Diagnosis of Acute Abdominal Disease. ZACHARY COPE, London. *The British Journal of Surgery*, October, 1922.

Any condition which may cause irritation of the diaphragm or the serous coverings of the diaphragm, or the contiguous tissues supplied by the phrenic nerve, may be the cause of phrenic shoulder-pain. Therefore, the diseases of the liver, stomach, duodenum, pancreas, and spleen below

the diaphragm, and the pleura and pericardium above it, will most commonly cause the pain. Usually it has the qualities of an ache, but sometimes it is very sharp and stabbing. From his long experience with this condition the author draws the following conclusions:

Pain of a referred nature is frequently felt on the top of the shoulder as a consequence of stimulation of the sensory terminals of the phrenic nerve in or near the diaphragm. The pain is felt in some part of the segmental areas corresponding to the 3rd and 4th and sometimes even the 5th cervical segments of the spinal cord. This referred pain is met with in many conditions which cause inflammation or irritation of the diaphragm or contiguous structures. There is an important localizing correspondence between the part of the diaphragm irritated and the position of the referred pain on the shoulder.

Acute abdominal conditions with indications of phrenic shoulder-pain are described.

Clinical Notes on the Diagnosis and Treatment of Gall-Bladder Disease. FRANK H. LAHEY. Boston. *Boston Medical and Surgical Journal*, November 16, 1922

A careful history is usually the most dependable feature in the diagnosis of gallstones.

There are no harmless gallstones and they should be removed as soon as diagnosed.

Cholecystectomy is in a great majority of cases the operation of choice, but is not universally applicable.

Obstructive jaundice usually demands delay and the use of measures to lower coagulation time.

Every dilated common duct and every common duct suspected of harboring a stone should be thoroughly explored.

Every case of cholangitis should have the common duct drained.

All successful bile passage surgery is dependent upon a long incision and adequate exposure.

Acute Mechanical Intestinal Obstruction. ROBERT CALDWELL. Nashville, Tenn. *The Journal of the Tennessee State Medical Association*, October, 1922.

The author concludes as follows:

The poison that is the cause of death in acute mechanical obstruction is a toxic proteose found in the gut above the point of obstruction. It is formed by protein catabolism of the body tissues and excreted into the gut. This excretory function of the gut is probably a compensatory one. The treatment is supplying the tissues with large quantities of fluids, relief of the obstruction, emptying the gut above the point of obstruction in all cases except where there is a wide margin of safety as determined by the non-protein nitrogen of the blood.

Treatment of Acute Intestinal Obstruction. L. L. SHEDDAN. Knoxville, Tenn. *The Journal of the Tennessee State Medical Association*, October, 1922

After a discussion on the pathology of this condition Sheddan advises the following:

As early an operation as possible; plenty of fluids before and after operation, either by proctoclysis or hypodermatoclysis or both; stomach lavage as often as necessary to keep the stomach free from toxic matter. When in doubt as to the integrity of a strangulated loop of intestine, always resect. If the gut is distended and paralyzed a well placed enterostomy is indicated.

Remarks on Chronic Endocervicitis and Its Treatment. JOHN WILLIAM BURNS, Liverpool. *The Lancet*, October 14, 1922.

Chronic endocervicitis should be recognized as a distinct pathological entity, apart from endometritis.

Any discharge from the vagina which induces discomfort in the patient is pathological and is usually due to chronic infection of the cervical canal.

That the condition is an infective one is proved by the fact that a positive culture can be obtained in 92 per cent of cases. In 50 per cent of cases the staphylococcus either alone or in association with some other organism is present.

Applications of various drugs, douching, tamponage, etc., only give temporary relief because the antiseptics do not reach the infecting agent deep in the lumen of the glands.

Ionisation will bring about marked improvement in those cases in which erosion is not present.

On theoretical grounds at least *ionisation* seems to be the only scientific method of applying antiseptics to the cervical canal. In endocervicitis the bacteria are in the gland lumen, and for a cure the antiseptic must be brought into contact with them. The patient is placed in the dorsal position with the knees drawn up. A medium-sized glass Ferguson speculum is passed until the cervix fits into the upper end. The os is dried and cleaned by means of small gauze swabs. A swab for bacteriological purposes is then taken from the cervical canal. The reaction of the cervical canal is then taken by means of litmus paper. A malleable zinc sound is passed into the cervical canal for about one or one and a half inches, the speculum is half filled with 0.5 per cent zinc sulphate solution. The zinc rod is connected with the positive pole of the galvanoset, the negative pole of which is applied to the patient's thigh by means of a metal plate superimposed upon two or three pads of gauze and lint wrung out of warm water. The current is slowly switched on and raised to 20 milliamperes. It is allowed to run 10 or 15 minutes, the os and cervical canal will then be seen to be coated with a thick white deposit. At the end of the requisite period the current is cut off and the sound removed. The zinc sulphate is mopped out, and a strip of gauze soaked in acriflavire (1:1000) is introduced into the vagina and removed at the end of 24 hours. This treatment is repeated weekly for three weeks, during which no douching or intercourse is permitted. The external genitals are washed with warm soap and water night and morning and kept quite dry. Three applications are usually sufficient to render the cervical canal sterile.

For those cases associated with erosion the only method which will bring about a cure is the removal of the lower two-thirds of the cervical canal including the erosion.

Radium in the Treatment of Menorrhagia and Metrorrhagia, with Case Reports of Forty Successful Cases. EDWARD T. NEWELL. Chattanooga, Tenn. *The Journal of the Tennessee State Medical Association*, October, 1922.

Newell divides his cases into two groups; those that are at or near the menopause, 35 to 40 years of age or older; and those from 20 to 35 years of age. In selecting cases with menorrhagia and metrorrhagia suitable for radium applications, it is important that the history of the case, the etiology, symptomatology, pathology and differential diagnosis of the conditions producing the menorrhagia should be thoroughly considered.

The treatment of these two classes of patients, while similar, differs materially in regard to the application, amount of radium used and time applied. While the pathology in the two classes of cases may be the same or quite similar it is very important, if possible, that the menstrual function in the younger class of women be preserved. If the patient is 40 years or more of age, use sufficient radium to check the excessive, or too frequent flow, at one application or stop the flow entirely.

In treating women under 35 years of age, the treatments should be of short duration, with moderate amounts of radium. The technic is described.

The Treatment of Carcinoma of the Uterine Cervix. STANLEY A. CLARK, South Bend, Ind. *The Journal of the Indiana State Medical Association*, October 15, 1922.

If one must operate, let him precede the operation by the maximum dose of deep *x*-ray irradiation, and let him follow his operation by radium within the vaginal vault, and a second course of *x*-ray treatment, not haphazard exposure of the abdomen to an undetermined dosage but carefully measured dosage applied to all sides of the pelvis.

Observation and personal experience has convinced Clark that the combined use of radium within the cervix and uterus and deep roentgenization from without offers the best hope to the average patient presenting herself to the surgeon for treatment of cancer of the cervix today. The results of this combined method are far from ideal, but it is the best we have to offer.

Retroversions of the Uterus Following Delivery. FRANK W. LYNCH, San Francisco, Calif. *The American Journal of Obstetrics and Gynecology*, October, 1922.

Retrodisplacements were noted in 41.1 per cent of 1230 cases which were accurately followed between four and twelve months after delivery.

Thirty-two per cent of the 505 retropositions came back because of pelvic symptoms. Ten and a half per cent of 725 controls with upright uteri complained of slight symptoms.

Nineteen and six-tenths per cent of 185 private cases presented retropositions in contrast to 44.8 per cent found in 1044 clinic cases. Hard work may, therefore, be an important etiologic factor in retrodisplacements.

Replacement of the uterus and pessary support gave anatomic correction in 72 per cent of the cases which wore pessaries. Symptomatic cure and anatomic correction were obtained by identical procedures in 86 per cent of the 161 cases presenting symptoms.

Subsequent pregnancies were observed in 15 per cent of a portion of the series in women who did not have displacements, in 10 per cent of women who had treated retropositions, and in five per cent of cases whose retroposition had not been corrected.

No one type of suspension has been entirely successful in our hands. There were two recurrences in 155 operations which made a new round ligament fixation upon the uterine fundus necessary (108 Webster, 31 Coffey, 16 atypical). There were four recurrences following 23 Kelly-Neel suspensions, together with the shortening of the upper part of the uterosacral ligaments.

The need of early correction of retropositions following labor is clearly evident.

The Relation of the Ureters to the Vagina; With a Note on the Asymmetrical Position of the Uterus. JAMES C. BRASH, Birmingham, Eng. *British Medical Journal*, October 28, 1922.

The relation of the last portion of the ureter to the vagina is variable. There is usually a portion of the ureter in front of the vagina, lying for a short distance in the connective tissue between vagina and bladder and then in the wall of the bladder itself.

With the vagina and bladder symmetrically related to each other this portion of the ureter is equal on the two sides; but deviation from the symmetrical position is the rule. The result is an increase of this portion of the ureter on one side and a corresponding decrease on the other. There is frequently no ureter in front of the vagina on one side and therefore a much longer portion than usual on the other side.

In the majority of specimens examined it is the left ureter that has the greater relation to the vagina, and it is occasionally found crossing the middle line of the vagina.

As a rule, therefore, the left ureter is in a position of greater danger than the right, both in operative work and from the point of view of the formation of a uretero-vaginal fistula as a result of pressure. It must not be forgotten, however, that occasionally the position may be reversed.

The "normal" asymmetrical position of the uterus in the pelvis is explained by the fact that an asymmetrical position of bladder and uterus is early established while these organs are still in their abdominal situation, by the subsequent greater relative descent of the bladder and its reassumption of a median position in the true pelvis which accentuates the asymmetrical position of the uterus and rotates it around its long axis.

Renal Colic in Cases of Renal and Ureteral Stone. HENRY H. MORTON, J. STURDIVANT READ, JOHN H. BURKE and WILLIAM B TATUM, Brooklyn, N. Y. *Journal of the A. M. A.*, November 11, 1922.

Of the thirty-two patients admitted to the hospital for renal or ureteral calculus whose cases are analyzed, thirty stated that they had come for the relief of pain. Twenty-seven described their pain as paroxysmal in character, starting over one kidney and radiating along the course of the ureter or remaining localized in the kidney region. Of the others, one complained of dull pain in the lumbar region; one had abdominal pain, first diagnosed as an acute condition of the abdomen; another patient sought relief for backache which had been diagnosed as due to spondylitis. Two of the patients who later proved to have calculi had had no pain or colic that they could recall, and were sent to the hospital for the relief of other symptoms, viz., pyuria. The duration of colic in this series presented a wide variation: in one case there had been an attack three days before admission and none before, while two of the patients had had repeated attacks for twelve years. The remaining patients had had attacks extending over three or four years before admission; this was found to be a fair average of the duration of colic. The authors urge that an early and complete urologic and roentgenologic examination should be made in every instance in which stone is suspected. Early operative intervention is indicated as a measure of prevention against destruction of the kidney. Stone in the kidney, if allowed to remain, eventually results in total destruction of the organ. Small calculi should be observed for a reasonable time before operative removal is attempted. Many of them will pass spontaneously or can be assisted by repeated dilation of the ureter.

The Mimicry of Ureteral Stone by Ureteral Stricture. JAMES NORMENT BAKER, Montgomery, Ala. *Southern Medical Journal*, November, 1922.

Baker encountered 7 whose symptoms and histories appeared quite typical of ureteral calculus, and yet, after a most exhaustive search, no stone was to be found at any point within the urinary tract. One of these seven proved, at operation, to be a moderate sized, long-pedicled ovarian cyst which had executed two complete revolutions about its own axis, thus accounting for the violent paroxysmal attacks from which this patient had suffered. The remaining six were proven to be due to definite ureteral strictures, whose symptoms cleared under appropriate treatment—that is dilatation.

It should be borne in mind that the urinary findings in both stone and stricture may be quite negative: no red cells, no white cells. Or again, stricture may yield the characteristic elements of stone, both red and white cells and even in fair quantities. The presence of blood, or blood and pus is corroborative evidence that one of these conditions is likely present. Their absence should not lull one into the feeling of certitude that neither exists.

The *x*-ray may be most helpful, if positive for stone, in that it accurately defines both the nature and location of the suspected trouble; or, it may be useless, or worse, if negative, because of its deterring effect upon further diagnostic progress.

The final resort in differentiating between the lesions is the renal catheter tipped with wax and armed with a bulb some ten centimeters from its end. A small unaided catheter may pass readily to the kidney in the presence of either stone or stricture without appreciable obstruction. If the waxed tip impinges upon or slips by a stone, a careful study of the wax, with the aid of a magnifying lens, can scarcely fail to reveal characteristic scratch marks.

Should no stone, but stricture, be present, the bulb, upon withdrawal of the catheter, will impart the sensation of a definite hang or grating, much like that obtained by the removal of an acorn-tipped bougie from a strictured male urethra.

Should neither stone nor stricture be present, this catheter will glide down the entire length of the ureter unimpeded and without effacement of its waxed portion.

Tumors of the Testicle. With Analysis of 100 Original Cases. CHESTER O. TANNER, San Diego, Calif. *Surgery, Gynecology and Obstetrics*, November, 1922.

New growth of the testicle occurs about once in 2000 male hospital admissions. The disease is practically always unilaterial—involving both sides only as a metastatic growth from the skin, seminal vesicles, etc. Trauma as an etiological factor in these tumors evidently has some foundation. Practically all cases occur between the ages of 18 and 50 years, the period of greatest sexual activity. Both testicles are involved with about equal frequency. Undescended testicles within the canal are more apt to become malignant than normally placed organs. Undescended testicles within the abdomen are relatively immune to malignant changes.

The average mortality of these tumors taken from the literature is about 80%, based on a 4-year postoperative period. In this series the mortality was found to be about 70%. The so-called mixed type of tumor gives a much higher mortality than the carcinomatous type. In this series it was 90% in the former type and 60% in the latter.

Tumors containing cartilage and squamous epithelium seem to have a decidedly unfavorable prognosis. The prognosis in abdominal tumors is also very bad—only 6% of a large series being alive and well 2 years after operation The radical operation should be performed in all cases in which the disease is apparently limited, i. e., in cases showing no abdominal metastases clinically. The ordinary castration operation, even when supplemented by Coley's serum, *x*-rays or radium, does not yield satisfactory results.

Carcinoma of the Prostate. ROBERT H. HERBST and ALVIN THOMPSON, Chicago. *Journal of the A. M. A.*, November 11, 1922.

The incidence of cancer of the prostate to that of benign hypertrophy varies in reports from 15 to 25 per cent. The differentiation of cancer by present methods of local examination is at times impossible, so that it is probably safe to estimate that at least one in four tumors of the prostate is malignant. Fully one-third of these patients give evidence of bone matastases at the time they seek relief, and many who do not show such evidence have extensive local involvement, or metastasis which are not demonstrable. For these reasons, it is evident that a rather small proportion of the patients treated are seen sufficiently early to give them permanent relief by any known method of treatment. The importance of a thorough investigation of the prostate gland in men more than 40 years of age undergoing a general physical examination is emphasized and is said to be the only measure by which better results from present methods of treatment may be expected. The signs and symptoms, pathology and treatment are discussed. The authors treat carcinoma of the prostate by embedding needles containing radium in the involved areas of the gland, through the opened bladder. A part of the failure to secure good functional results following irradiation of the malignant prostate is attributed to the fact that, in a large percentage of cases, the carcinoma is associated with benign hypertrophy, the radium having little or no effect on the adenomatous lobes. This usually occurs in the middle lobe, and the hypertrophied tissue must be enucleated to relieve the obstruction. Again, many of these patients cannot be examined cystoscopically, and the middle lobe will not be found until the bladder is opened. The perineal method and the intra-urethral applications of radium are used by the authors as supplementary forms of treatment.

A Study in the Diagnosis of Cancer by Means of Serum Reactions. J. A. SHAW-MACKENZIE, London. *The Lancet*, October 7, 1922.

Shaw-Mackenzie draws attention to a new test of cancer by means of a turbidity reaction in the serum. The test resembles Freund's test, but differs from it in important particulars. It consists in adding an ether extract of cancer tissue, with or without saponification, to cancer serum. This is followed by an appearance of turbidity after incubation which does not appear at all, or not to the same extent, with non-cancerous serum. It is essential that the serum used should be as clear as possible; if turbid to start with the test becomes difficult, for then one has to judge relative turbidities. This difficulty is especially marked in diabetic cases. Tests have been made of 135 sera, including 58 normal sera. In 41 cases a previous positive or negative diagnosis has been confirmed by the test. In 35 cases in which no details of the cases have been given or the diagnosis was uncertain, a correct diagnosis was made as determined subsequently.

A Roentgenological Contribution to the Diagnosis of Spinal Carcinoma in Cases Having an Unrecognized Primary Focus. THOMAS SCHOLZ, New York. *New York Medical Journal and Medical Record*, November 18, 1922.

Early diagnosis of spinal metastasis in cases showing no apparent primary focus is very difficult. It may be arrived at by means of a thorough and careful analysis of its only symptom, pain, and a careful observation of the course of the disease with its characteristic remissions.

Sciatica in elderly people, especially if bilateral, is suggestive of neoplasm of the lumbar spine.

Radiographic examinations may become of great diagnostic help early in the disease. They should be made repeatedly and they should not be limited to the part of the spine called for, but should include the entire spine and such other parts of the body as may be suspected of having some bearing upon the diagnosis, especially skull and upper parts of the femora.

The radiographic appearance of the metastatic changes may give a suggestion regarding the true nature of the unknown primary focus.

Carcinoma of the Larynx Treated Locally with Radium Emanation. A Clinical Report. OTTO T. FREER, Chicago. *The Journal of the American Medical Association*, November 4, 1922.

There were thirty-two cancers of the larynx in the patients treated by Freer, by intralaryngeal irradiation. Three of these patients were moribund when received, and soon died. In thirteen patients, including those that were moribund, the disease was far advanced when the treatment was begun. In twelve cases, it was also advanced, so that in twenty-five of the patients treated the cancer was in an advanced stage. In only seven it was in an early stage. Four of the cancers were very resistant to irradiation. In two of these, early hopeful progress was followed by no further response to the rays; in a third, there was an excessively prolonged reaction which had not ceased when the patient died of pneumonia. In the fourth case, after temporary improvement, the cancer progressed irresistably, with only temporary checks until the patient died. In eleven patients, speedy, complete disappearance of the cancer and its symptoms was followed by a return of the growth, the average time between the last irradiation and the return being four and one-half months. In seven of these patients, the advanced state of the cancers predisposed to a relapse, all being of the type called inoperable, with large tumors and deep invasion of the tissues. In four of these recurrences, the cancer was again removed by renewed irradiation with no second relapse so far, and a fifth was being successfully treated when the patient died of heart failure. These four cases, with ten in which the cancer disappeared without return after the first irradiation, make fourteen from whom the cancer was completely eliminated, or fourteen among thirty-two who became clinically well. Deducting the three moribund patients from this list leaves fourteen patients of twenty-nine, or close to 50 per cent, who recovered clinically, a good percentage considering that in twenty-five of the thirty-two patients the cancer was in an advanced stage of development, and that thirteen of the patients had extrinsic cancers, that is, cancers that were inoperable by laryngectomy. Twelve patients died: seven as a direct result of the cancer, five from general causes. Freer's experience has confirmed his opinion that emanation irradiation used as described is the best existing treatment for carcinoma of the larynx, in spite of possible recurrences.

Streptococcus Hemolyticus Mastoiditis. A. M. DUNLAP, Peking, China. *The Laryngoscope*, October, 1922.

Dunlap reports an epidemic of septic sore throats in Peking last year in which the streptococcus hemolyticus was the predominating organism in all throat cultures Mastoid complications resulted in a great many cases from all of which the streptococcus hemolyticus was obtained in pure culture.

There was no previous illness which might have acted as a predisposing cause and adenoids and tonsils played no part as starting points for secondary invasions. The epidemic character of the septic sore throats, the clinical similarity of all mastoid complications and the result of the bacteriological study justify the conclusion that one had a single type of the streptococcus pyogenes to deal with. The author states that these cases, therefore, belong to a distinct group and the disease should be known as streptococcus hemolyticus mastoiditis. Fifteen cases are described in full detail. Dunlap also discusses the pathology and treatment of this condition.

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REBREATHING AND ETHERIZATION.*

JOHN R. McCURDY, M.D.,
PITTSBURGH, PENNA.

Methods of administering ether for surgical anesthesia has been a fertile field of argument and research since the days of Long and Morton. Published history does not tell us the exact method employed by these pioneers. Long removed the tumor from Venable's neck "by giving him ether to inhale." Morton's first experiment on a human subject was when he himself "inhaled ether from a handkerchief while sitting in his operating chair." He later devised an inhaler—which is still in existence—that carried ether vapor to the patient in a more indirect way and may have embraced some small degree of rebreathing, but was inflexible and evidently not intended for a rebreathing apparatus.

In the succeeding years methods and technic were necessarily indefinite and varied. The weight of opinion among anesthetists, however, seemed to favor closed or partly closed methods. This was particularly so in England where closed methods still predominate and the development of apparatus has been much more prolific and varied than in the United States. There may be good reason for this in the peculiar climatic conditions and also in the fact, that until within very recent years, British chemists did not produce a good ether. Both these factors may also explain in some degree why chloroform has been used much more than ether, as compared to the United States.

Just when the prevailing method of "open" or "open drop ether" became generally adopted in this country I am unable to state, but it has been taught and practiced for over 20 years. Many of our best anesthetists use this method more than any other—some refuse to use any other method—and most nurse and interne anesthetists know no other. There are unquestionably arguments in its favor—simplicity, convenience, cheapness, free-ventilation and oxygenation. There are, on the other hand, just as forceful arguments against the open method as generally practiced. We seem to sense a tendency at present—perhaps fostered by laboratory research and the production of improved apparatus—for the pendulum to swing back toward closed methods of etherization.

Rebreathing of ether vapor for anesthesia implies a partial or complete closed method with apparatus by which varying proportions of exhaled ether and other gaseous substances are kept from admixture with the surrounding atmospheric air and are again taken into the lungs by inhalation,—in contradistinction to the so-called "open" or "open-drop" method in which there occurs free and unrestricted interchange of exhaled gases with the surrounding air.

THE QUESTION OF OPEN OR CLOSED ETHERIZATION.

To the anesthetist and the surgeon the practical question is "Which is the best method?" Meaning the *best for the patient* in the ultimate analysis. (Unfortunately, "best anesthesia" in the minds of some surgeons does *not* imply an ideal condition of the patient's safety or welfare either during or after the operation.)

It should be needless for us, as anesthetists, to guard against the use of any technic or methods injurious to our patients, in our anxiety to achieve the good will and compliments of the surgeon. Nor should we allow ourselves to become so impressed with the merits of a particular method of administration as to apply it to all cases to the entire exclusion of other methods.

Is the closed technic better than the open drop? Is rebreathing a desirable and beneficial element or one to be avoided as injurious or disadvantageous?

The whole question seems to center about the one element *carbon dioxid* and its tension or relative volume in the blood and tissues during anesthesia. Any amount of rebreathing, if maintained for more than a few breaths' duration, causes a relative change in the carbon dioxid tension. The ratio of this change varies directly with the per cent of tidal air rebreathed. There occurs, therefore, a gradual and progressive accumulation of surplus, or overload of carbon dioxid—increased carbon dioxid tension—in the blood and tissues, which hypotheically, will go on to carbon dioxid poisoning, or asphyxia. Practically, of course, this is regulated and controlled by the amount of oxygen admitted (atmospheric or artificial), the amount of exhalation permitted to escape and the amount of ether vapor added to the inspired air. Another very important element enters into this control, to greater or less extent, in every closed ether apparatus, namely *pressure*. By this we understand an intrapulmonic pressure in excess of the normal, created either *negatively* by flexible resistance to exhalation, or *positively* by mechanical force added to inhalation. (This pressure factor is to be discussed in another paper.) Comcomitant with the increased carbon dioxid tension there is a relative

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diminution in the oxygen content of the blood. Other factors to be considered are heat, moisture and waste products of metabolism, other than carbon dioxid in the expired air.

VARIATIONS IN CARBON DIOXID IN RELATION TO REBREATHING.

Of all these factors in rebreathing of ether we believe the variation in carbon dioxid to be the most important. Let us, therefore, first inquire into its influence on the patient. Bryant and Henderson[1] state that: "Under all anesthetics the rate of production of carbon dioxid is subnormal"—that is *without* rebreathing—but that rebreathing "prevents loss of an excessive amount of carbon dioxid—a normal and necessary physiologic stimulant". Hence in rebreathing we may see a better respiration, blood pressure, circulation and intestinal tone, or a better condition of patient in general. This may be accepted as clinically true *within proper limits of rebreathing.* What, therefore, are the proper limits?

From 55 to 77 volumes per cent is considered by physiologists the normal alkali reserve of the blood, and 40 to 45 volumes per cent normal carbon dioxid content. Carter[2] has shown by animal experiments that ordinary ether anesthesia, without surgical shock of any kind, causes a distinct decrease in the alkali reserve and in carbon dioxid combining capacity, which decrease is apparently greater after the first hour of anesthesia and is greatest at the end of continuous anesthesia, but averages only about 6 to 10 volumes per cent and is never severe enough to cause acidosis. It must be remembered, however, that Carter's experiments were all upon healthy dogs in which it is difficult to produce acidosis, and that practically all patients come to operation in a state of lowered alkali reserve from altered metabolism due to disease or starvation or from surgical shock. Add to this condition the further relative hypocapnia induced by operative shock and it would appear that the reduction in alkali reserve and carbon dioxid combining capacity caused by ether *per se* is but a small proportion of the whole damage. Nevertheless, it is a proven factor and should be minimized by whatever means are at command. Further experiment by Carter, with an apparatus for rebreathing, showed that ether vapor alone in ordinary atmosphere caused an increase in respiratory *rate* of 107 per cent, but only 33 per cent in respiratory *volume,* while an atmosphere containing 2.5 to 3 per cent of carbon dioxid increased the respiratory *volume* 74 per cent but the *rate* only 7 per cent.

EFFECTS OF OVERVENTILATION, CARBON DIOXID AND OXYGEN.

This brings up the question of overventilation and its effects. The work of Haldane, Henderson and others has apparently proved that ordinary breathing is not controlled so much by oxygen needs as by carbon dioxid output and blood content; and that if by abnormally excessive respiration the carbon dioxid reserve is considerably reduced there follows a compensatory period of sub-normal respiration with cyanosis, suboxygenation and perhaps respiratory failure, (a condition termed "acapnia" by Henderson). It is, however, only partially true that respiration is not controlled by oxygen needs, for we have frequently seen temporary complete cessation of respiration when the blood has been suddenly flooded with oxygen, following the anoxemia of primary nitrous oxid saturation or of mechanical asphyxia. Exception to this theory has been taken by Ferguson, who claims that depressed respiration under ether is not due to relative acapnia but to physical tiring of the respiratory mechanism, including the brain centers—a degree of exhaustion. Whatever may be the correct theory, we believe there is indisputable clinical evidence that carbon dioxid is a powerful and circulatory stimulant. Henderson, Haggard and Coburn's[3] brief report of the use of known quantities of carbon dioxid in postoperative depression has shown us its value—notwithstanding the disagreement of Reimann[4] to some of their clinical results.

The author has for the past 7 years been using a mixture of 10 per cent carbon dioxid and 90 per cent oxygen in all conditions of depressed respiration and circulation during ether anesthesia. It is exhibited from the ordinary oxygen cylinder—wash bottle outfit by placing the outlet tube under the ether inhaler or connecting the tube to any insufflation apparatus (the Connell instrument preferably).

The almost immediate effect of increased respiratory rate and volume, stronger pulse and elevated blood pressure is most striking. The author has learned to depend upon this stimulant to the almost entire exclusion of hypodermic medication, and has never seen either the slightest ill effect or failure to yield good results. It is unnecessary here to multiply laboratory and clinical evidence that carbon dioxid is a respiratory stimulant and that increased carbon dioxid tension of the blood is accompanied by increased total ventilation,—rate times volume.

We submit, therefore, that rebreathing of ether vapor, to be non-injurious, beneficial and scientific

must be measurable, flexible and adjustable as to volume, percentage of carbon dioxid and oxygen and pressure at the will of the anesthetist and be accommodated to the particular needs of the patient under varying conditions of pathology, metabolism and surgical shock. To date no instrument has been devised to meet these requirements. The technic of McKesson for the fractional rebreathing of nitrous oxid-oxygen suggests a working basis. How we may gauge and control the changing carbon dioxid tension under ether anesthesia and adjust carbon dioxid conservation or supply to maintain or approach a normal balance is the problem. In McKesson's nitrous oxid-oxygen technic the volume of overventilation is the gauge and possibly this might be sufficiently accurate for ether. But, existing haphazard methods of rebreathing, without definite knowledge of the proportions of carbon dioxid and oxygen exhibited or measure of pressure induced do not appear entirely justifiable, though possibly not seriously harmful.

Of the other factors in the rebreathing of ether, pressure, as already mentioned, is perhaps the next in importance. A variable amount of intrapulmonic pressure is, as we have said, present in every closed method, though more or less indefinite and irregular. Is it advantageous or injurious? Clinically it seems to contribute two distinct advantages: (a) greater relaxation of musculature and (b) a lesser amount and concentration of ether for relative planes of anesthesia. A third might even be granted, namely (3) shorter induction time. *Rebreathing with pressure seems also to cause a mild degree of peripheral analgesia. Whether this is due to engorgement of the peripheral capillary vessels and consequent pressure on terminal nerve filaments, or to the increased carbon dioxid tension alone, or to both factors does not appear clear. Practically, however, it proves an advantage to the patient, especially in the induction stage when it diminishes the irritability of nose, throat and bronchial membrances. It may indeed be possible that this analgesia contributes to the quietness and relaxation of the patient during the surgical stage—a distinct advantage to the operator—by partially protecting the brain from operative trauma. The principle of diffusion of gases through a porous membrane—lung tissue—also has a bearing here,—the positive pressure in the lung cells causing a more rapid transfusion of the dilute ether vapor into the blood stream.*

Clinically it is observed that the average pulse rate under rebreathing with pressure is lower and more even than under open methods. This would appear at first glance to be a distinct merit, for, unquestionably, if we can overcome the "heart whip" effect of ether we are rendering a vital service to the patient. One of the chief arguments for spinal anesthesia is the markedly quiet action of the heart—total abscence of stimulation. Now if this condition is due to the influence of carbon dioxid tension on the centric and vagus mechanism of the heart it would appear beneficial. But if it were due to increased intrapulmonic pressure, with possible engorgement of the right heart, then we seriously question its defensibility. Further investigation may enlighten us on this point.

The question has been raised whether excess intrapulmonic pressure traumatizes in any degree the alveolar cells. Autopsy records, where available, do not mention any damage that might be attributed to pressure and we are of the opinion that such could only occur by accident or under circumstances entirely foreign to proper surgical anesthesia.

DIMINUTION OF OXYGEN SUPPLY.

The next factor in rebreathing is diminution of oxygen supply. This is not a serious disadvantage if the technic is good. By this we mean that any apparatus for the rebreathing method should permit of free and prompt addition of pure oxygen as well as air and the withdrawal of excess carbon dioxid and waste gases from the rebreathing bag at the will of the anesthetist. Deprivation of oxygen in any considerable proportion is always injurious and protracted anoxemia produces acidosis. Morse[5] asserts that depth of anesthesia increases directly as oxygen decreases and that "the tendency to reinforce the action of the anesthetic with very slight degrees of asphyxia is constantly present in a closed method". Sufficient oxygen should at all times be exhibited to maintain a good color of the skin.

The heat and moisture accumulated in the rebreathing bag from exhaled air and ether constitutes a slight advantage in making the ether vapor easier to breath and to some extent molifying its irritant effect on the larynx, bronchi and lungs.

Other waste products in the rebreathing bag may be disregarded as "physiologists agree there is no toxic organic substance in exhaled gases" (McKesson)[6]. The question of transmission of tuberculosis and other infections of the lungs and upper air passages has been raised but is more academic than actual, provided the bag is kept reasonably clean.

SUMMARY.

To summarize:—

1. Rebreathing of ether in onesthesia modifles the carbon dioxid tension of the blood and may be employed to the benefit of the patient.

2. Apparatus for rebreathing should be capable of complete and flexible control as to the proportion of carbon dioxid and oxygen.

3. A modified and adjustable *closed ether method* may yield a better anesthesia than the ordinary *open-drop method* in points of induction stage, muscle relaxation, muscle and intestinal tone, lesser amount and concentration of ether and possibly in better heart action and postoperative recovery; these effects are apparently enhanced by the employment of suitaby adjusted pressure.

4. Sufficient oxygen must at all times be exhibited to prevent suboxygenation and maintain a good color.

5. Existing crude, unsafe and careless use of *open* and *semi-open drop methods* by untrained anesthetists should be vigorously discouraged, and the possibilities for better anesthesia by rebreathing methods further developed and taught.

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TISSUE ACIDOSIS VS. BLOOD ACIDOSIS.*

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This brief paper is written for therepeutic purposes only. Certain facts in literature concerning the subject of acidosis are only briefly mentioned and summarized in order to make clear certain definite therapeutic indications. The fundamental theories of acidosis have so often been presented in recent writings, principally by James I. Whitney, L. G. Rowntree, Andrew W. Sellards, and Albion W. Hewlett, that it is hardly necessary to cover the ground anew, further than to state that my conception of what acidosis is, either a blood acidosis or a tissue acidosis, is comprised in two very comprehensive definitions, one by A. W. Sellards and one by A. W. Hewlett.

DEFINITIONS OF ACIDOSIS.

Definition by Dr. Sellards:—"An acidosis is a diminution, from any cause, in the reserve supply of fixed bases in the blood or other tissues of the body, the physicochemical reaction of the blood remaining unchanged except in very extreme conditions."

Definition of Dr. A. W. Hewlitt: "Acidosis is due to the formation or retention in the body of an excess of non-volatile acid substances. As a result of the process, the blood carbonates are in part decomposed and their quantity lessened."

ETIOLOGICAL FACTORS.

These two definitions, if accepted, point the way very clearly to rational methods both of diagnosis and therapeutics. Dr. Sellards, in his recent valuable little book on "The Principles of Acidosis and Clinical Methods for Its Study," states that it is only necessary to classify acidosis according to its etiology and that it is not necessary to subdivide the principles upon which the theory of acidosis rests.

Dr. Whitney, whose most valuable studies on acidosis are well known, sums up, as follows, the etiological factors under four general groups:

1. *Overproduction of acid due to deficient oxygen*, such as severe exercise, mountain sickness, acute anemia, gas poisoning and asphyxia, decomposed heart lesions.

2. *Conditions where a primary lack of oxygen* leads to a compensatory raising of the threshold for acid, such as acidosis of high altitudes, acidosis of pregnancy.

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3. *Metabolic conditions* in which abnormal acids are produced in large amounts such as in diabetes mellitus, starvation, postoperative toxemias, diarrheas and cyclic vomiting in children.

4. *Kidney inefficiency,* such as in chronic nephritis, and pus kidney.

CONFUSION IN THE NOMENCLATURE OF ACIDOSIS.

If, therefore, these various groups of possible etiological factors are borne in mind, the possibility of an early correct diagnosis will be much facilitated. The author has found, in making a comprehensive study of the subject of acidosis, that the nomenclature adopted in discussing acidosis in current literature is most confusing. Whenever it is necessary to refer to current medical literature, references are secured *first,* under certain classifications; and *second,* under certain nomenclatures or nosological headings.

As a rule, it is a comparatively easy matter to look up the literature concerning a special disease or condition under some of the well recognized and accepted classifications of diseases, especially those which deal with disease conditions strictly from an anatomical or etiological standpoint. The matter, however, becomes much more complicated and confusing when we approach our subject from the standpoint of our present nomenclature. This is especially confusing when we attempt to deal with a broad general subject, such as acidosis, which has so many different phases and can be aproached from so many angles.

I recall, very vividly, attending a symposium on Acidosis in May, 1916, before the Association of American Physicians in Washington. Before the discussion began, I thought I had a few definite, more or less fixed, ideas on the subject, but before the symposium was over, I was so confused that I did not know whether I was standing on my head or my heels, and the little that I thought I knew had vanished. Dr. Yandell Henderson, professor of physiology at the University of Yale, partially saved the situation for me by pointing out, in closing the discussion, that the matter was really not quite so confusing as it seemed, because everyone was really talking about the same subject, but was approaching it from a different angle, and that even when their views were the same, the nomenclature, which they used to express their views was different, although all really meant one thing. Assuming that there were ten possible expressions, any one of which could indicate the same thing, and that ten different men each selected a different one of these ten, one can easily imagine the confusion that arose in that discussion.

It might be well to emphasize again the fact that there are only two well recognized methods of playing the scientific game, and if those of the medical profession, whose aim it is to assist the profession, either by writing or by teaching, would strictly adhere to the rules which govern these two methods, much time would be saved, and, incidentally, much less would be written. The first method is to collect your facts, and then try to adjust your problem to these facts; and, second, to assume a plausible hypothesis as a possible explanation for certain problems and then try to prove your hypothesis from facts. Both are valuable and necessary under certain conditions, but neither should be confused with the other. There is nothing so confusing as to listen to a man, or to read what he writes, when he is constantly confusing his facts with his hypothesis. In the present communication, the author will endeavor to confine himself strictly to the first method and only in one instance will make use of the second method.

HYPOALKALINITY.

1. *Tissue Acidosis vs. Blood Acidosis,* or (2) *Hypoalkalinity of Tissue and Blood* (*Sellards*). My title in the first place is a misnomer and a most unfortunate use of the term; as, strictly speaking, neither the tissues of the body nor the blood can be said ever to be acid in the usual sense of the word. Hence, the title adopted by the author, suggested by Dr. Sellards, of hypoalkalinity, is much to be preferred from an etiological standpoint. In this connection, I would like, briefly, to call your attention to certain comparatively recent facts which have quite a practical bearing on the subject we are discussing. *First,* the recent epidemic of acute anterior poliomyelitis, commonly, but most erroneously, called infantile paralysis, for the facts brought out in the study of this condition proved conclusively that only about 10 per cent of the cases affected have paralysis, and that individuals reacted, in this disease, strictly according to their individual powers of immunity; so that some of those exposed established their immunity in less than twenty-four hours, with the production of but few symptoms, while others would go on to the state of paralysis, or die before that stage was reached. In like manner, the late war taught us a similar lesson in regard to epidemic cerebrospinal meningitis. Dr. Herrick, of New York, in a masterly review of hundreds of cases seen by him in an army camp, demonstrated the fact that

the same was true in this disease and that the meningeal syndrome was but a late manifestation of its symptomatology.

The author would like to draw a similar comparison in discussing the subject of acidosis and to emphasize the fact that an acidosis may be either very mild or even most transitory in character, at one extreme of its origin or development, and very severe and dangerous at the other; and also, that in between these two extremes, a large number of intermediate varieties can be found. He is convinced that heretofore our attention has been so fixed, by various authors, upon the importance and the dangers of the more or less terminal forms of acidosis, that we have neglected, not only to recognize but especially to treat the very large number of mild cases of acidosis. To recapitulate, we have been taught to diagnose acidosis clinically only when it has reached a far advanced stage of its normal development, exactly as formerly we regarded, clinically, acute epidemic anterior poliomyelitis and epidemic cerebrospinal meningitis.

These remarks will be limited chiefly to the subject of the early diagnosis and treatment of the very mild cases of acidosis with which the author has had considerable personal experience, and he would like to point out in this connection the desirability of some one making a careful study of the corresponding mild cases of alkalosis.

THE DIAGRAMATIC CONCEPT OF HYPOALKALINITY.

What, then, are the well-established facts so far as they have been observed and substantiated in regard to acidosis or hypoalkalinity?

Several years ago, a friend of mine, who had given a great deal of attention to the chemistry of the blood and especially the laboratory methods of studying it, expressed to me, briefly, his views by making use of the following diagram. The diagram has been so valuable to me in following up advances in this subject, that I am going to reproduce it here for my guidance, in making clear to you, the therapeutic points which I wish to bring out and to illustrate.

20 per cent "Buffer Salts." 80 per cent.
A.——————————————————B.
Acid Radicles Alkaline Bases.

Imagine all the blood in the body to be represented by a straight line A to B. The blood is a fluid proximately, of 80 per cent of alkaline bases and 20 which from a chemical standpoint is composed, apper cent of acid radicles. This proportion, which usually is remarkably constant, is held in balance by what Rowntree has recently most beautifully described as "the buffer salts of the blood." When the blood is thus delicately in balance, it is possible to eat almost any quantity or variety of food and the end results of all food metabolism, be it either that of an alkaline base or that of an acid radicle, will be the same, for the "buffer" (when in good working order) promptly takes up an excess on either side and thus the delicate balance is not materially changed. When, however, anything goes wrong with the "buffer" or fly-wheel, then trouble begins and we have either an acidosis on the one hand or an alkalosis on the other; either of which may be accompanied by most serious conditions, especially if either is prolonged or far advanced.

Let us now continue the study of our diagram and analyze, a little more in detail, what are the facts about our 20 per cent of acid radicles. Let the upright line represent, diagrammatically, the acid content of the blood. Of this, 15 per cent of its bulk (approximately) is made up of volatile acids and the balance of (approximately) 85 per cent is non-volatile acids. The 15 per cent of volatile acids are thrown off, principally, through the lungs as carbon dioxid gas. The 85 per cent of the non-volatile acids are excreted principally through the urine and very slightly through the feces.

15 per cent { Volatile Acids Carbon dioxid } Lungs

85 per cent { Non-Volatile Acids } Urine and Feces.

THE BREATH HOLDING TEST.

This diagram makes it quite evident that, if the non-volatile acids, as a result of deficient elimination, accumulate in the blood, the volatile acids will be thereby compressed and the amount of carbon dioxid thrown off through the lungs will have to be increased and thus the power to hold the breath will be more or less diminished. This is the rational explanation of the clinical value of the breath holding test of Henderson.[1]

Henderson's directions are as follows—"(1) Sit quiet for five minutes. (2) Draw a full, deep, but not too deep, breath. (3) Hold it with mouth closed and nostrils compressed with fingers. (4) Note time. Usual normal period which breath can be held is 45 seconds. Between 30 and 40 seconds indicates a mild acidosis; between 20 and 30 seconds indicates a high degree of acidosis."

NECESSITY OF COMBINING ALKALIES WITH DIURETICS AND LAXATIVES.

Whitney, of San Francisco, in two recent articles,[2]

makes a very practical clinical suggestion which the above diagram beautifully illustrates; that it is not only necessary to give alkalies to neutralize an acidosis but that it is equally necessary, owing to the extremely loose chemical association of some alkalies with acids, to combine the alkali with either a diuretic or laxative. This latter observation is so evident and so convincing that it is surprising that no one had pointed it out before. It has been the personal experience of the author to have had the most brilliant therapeutic success when giving alkalies when the symptoms pointed distinctly to an acidosis, and also to have as great a failure when a few days later he gave alkalies under apparently similar conditions. I am free to admit that I formerly omitted giving any more alkalies in these cases; as I concluded that my patient had some idiosyncracy to that particular alkali which I was using, and the idea never occurred to me that my failure was due to the fact that I had not combined my alkali, as Whitney suggests, with either a diuretic or a laxative to carry it off.

ACIDOSIS AND PHAGOCYTOSIS.

Before proceeding to the main point of my paper, the treatment of tissue acidosis vs. blood acidosis, let me refer in passing to a most important series of experiments that have recently been published in the *British Medical Journal* by Hamburger of Gronningen, Holland, in regard to the action of mild degrees of acidosis on the leucocytes, especially in regard to their phagocytic action. *His experiments show that normal white blood cells in a blood with a proper balance between alkali and acid bodies can normally take up* 50 *per cent of their bulk of bacteria, but that the instant this balance is lost, even to a slight degree, they can absorb only* 25 *per cent of phagocytes.* In other words, the great practical bearing of his researches was to show that in any infection, associated with an acidosis, alkalies are always indicated in order to raise the powers of our leucocytes (of our little white soldiers) to resist disease from 25 to 50 or 100 per cent.

TISSUE ACIDOSIS VS. BLOOD ACIDOSIS.

Returning to our principal subject. What clinical signs have we at our disposal to distinguish between a mild blood acidosis and a mild tissue acidosis? Which begins first? Does the tissue acidosis affect the blood or does the blood acidosis affect the tissues? Frankly, I do not know. Both Fisher and Henderson assume that the process begins in the cells and through the cells ultimately reaches the blood. Others take the opposite view. Clinically, it would seem as though the acidosis should reach the cells through the blood.

We now have many simple, reliable, and easily carried out methods, by means of which we can determine whether our "buffer" has lost its power, and I am inferring, although I have no scientific facts to prove, or proofs to sustain, my contention, that if the buffer is not acting, and this continues for any length of time, the blood which is constantly bathing all the tissues, will in time give them more or less of an acid imprint, which remains for an indefinite period. In treating these cases, therapeutically, I first try to determine this point and in all cases in which a tissue acidosis is assumed, I tell the patient that the treatment will be a long drawn out one, and will involve a more or less constant use of alkalies, probably for many months.

EARLY DIAGNOSIS OF BLOOD AND TISSUE ACIDOSIS.

The two simplest and most easily carried out tests are (1) The breath-holding test of Henderson. (2) Litmus paper test; (a) Saliva. Normal is alkaline before meals, acid after. (b) Urine. Normal acid. (c) Stool. Normal alkaline.

Both of the above tests are reliable and easily carried out and, when positive, indicate when treatment should be begun.

Some of the simplest and most easily carried out chemical and laboratory tests are

1. Reaction of blood serum to phthalein.

2. Ingestion of sodium bicarbonate on reaction of urine (Sellard's test). Five (5) gm. sodium bicarbonate is given by mouth; the urine should be neutral or alkaline in three hours if normal.

3. W. J. Bruce[3] gives the following simple test for determining the reaction of the stool. Prepare first a 1 per cent solution of alizarin. (a) Place then on a slide two drops of this solution 1½ inches apart; one of these drops in the control. (b) Use a glass rod which has been dipped or thrust into feces either liquid or solid. Mix thoroughly with one of the drops. Alkaline reaction=reddish violet to violet. Acid reaction = light yellow. Neutral = no change.

4. Another very simple and easily applied test has recently been suggested by C. Mitchell[4] which he calls the iodin color test for determining whether acidosis exists; for he points out that the acidity of the urine alone is not to be depended upon as a sure diagnostic sign of acidosis nor is the presence of acetone bodies, nor a chemical reaction to ferric chlorid, as these reactions may be caused by other

non-specific factors. A busy practitioner requires most of all a simple trustworthy urine test which may be carried out without special apparatus and chemicals difficult to obtain. The technic of the test he suggests is as follows:—

Add to 145 cc. water 3 cc. Lugol's solution, and 2 cc. Sat. solution of picric acid. Mix thoroughly. The result is a clear bright reddish liquid. Pour this liquid into a white dish and heat gently (do not boil) until fumes are abundantly given off. To this hot liquid add urine as follows: (1) Normal acid urine up to 15 cc. does not change color of above hot fluid. (2) Urine, although acid, but which indicates an acidosis in amounts from 2 cc. to 10 cc., will change the above liquid from a bright reddish color to a bright yellow.

Among other early symptoms which may be mentioned are the following: Slight mental irritability; a tendency to hives and eczema; a tendency to a low-grade conjunctivitis associated with subconjunctival hemorrhages and a collection of matter in the inner corners of the eyes. Presence of a heavy or disagreeable breath is also a very important and reliable early symptom.

TREATMENT OF ACIDOSIS.

To be correct and efficient, treatment must depend not only on the etiology of acidosis but also on the fact whether it is a mild or severe case. A mild acidosis treated with too much alkali can easily be converted into an alkalosis.

1. If the etiology indicates that the "buffer salts" are defective from any cause, give alkalies such as the carbonates and citrates of sodium, potassium, and calcium.

T. C. Ely[5] quotes A. Taylor as saying: "As the acids circulate in the system, they abstract from the tissues sodium, potassium, and calcium and disturb the equilibrium of the basis elements in the tissues. Obviously the correct therapeutic measure is not to administer only one type, but a mixture of sodium, potassium, and calcium in order to restore the equilibrium."

2. In acidosis of nervous origin, which is quite often associated with disturbances in the action of the buffer salts, the old prescription known as pil. sumbul comp., which contains Hyoscyamus, ½ grain; Camphor, 1 grain; Powdered Valerian, 1 grain; Ext. Sumbul, ½ grain, is often of surprising value. It can be given as often as once every half hour for three or four doses.

3. In cases where on endocrine loss of balance is suspected as a cause of acidosis, the use of chromium sulphate in four grain doses usually works surprisingly well. The author has given this remedy empirically for a great many years. He has no explanation to offer why it should have such a good effect other than hazarding the hypothesis that chromium may in some chemical way influence some of the endocrine glands.

4. Treatment of acidosis due to certain diseases, as diabetes mellitus, starvation, after surgical operations, cyclic vomiting, diarrhea, infectious diseases of childhood, nephritis and other diseases of kidney should vary with the disease in question.

5. It should not be lost sight of that acidosis may be due to carbohydrate excess. Both W. J. Stone[6] and W. Tileston[7] have commented on this matter.

6. Various gastrointestinal disturbances are often associated with a mild or a severe acidosis.

7. The influence of diet upon treatment, in acidosis, does not, as yet, seem to have much clinical value.

8. Transfusion from an alkalinized donor as suggested by the late Edward Lindeman.[8]

9. As a rule, give small doses at short intervals, rather than large doses at long intervals.

In conclusion, the following explanation might prove of interest of why less meat is a good treatment for acidosis. During protein digestion, the sulphur and phosphorus are oxidized to sulphuric acid and phosphoric acid. These would acidify the blood at once were it not for the presence in the blood of salts of sodium, potassium, calcium, and magnesium. When these fixed alkalies are insufficient to neutralize the acids produced, the organism makes use of a mechanism for neutralizing the excess as follows: Amino acids passing through the liver and muscles are de-amidized. That is, the amino group

$$\left(\overset{+}{H}\right) = K \times \frac{H_2CO_3}{NaHCO_3}$$

Diagram 1.

(N H) is broken off and changed to ammonia. Further, this ammonia together with water and CO_2 is converted into urea and this is excreted by way of the kidney. If, however, the blood stream brings to the liver unneutralized sulphuric acid and phosphoric acid molecules, owing to the lack of fixed alkali, then the ammonia mentioned above neutralizes the acids and is execreted as ammonia salts. Thus, the more acids produced in the organism, the more ammonia salts and the less urea are found in the urine, and vice versa.

WHY ACIDOSIS CAN BE SUCCESSFULLY TREATED WITH ACIDS.

In the *American Journal of the Medical Sciences*, January, 1917, J. Harold Austin gives the following information: The normal reaction is maintained by three methods: (1) Presence in the blood of (a) sodium bicarbonate and other salts; (b) two weak acids, carbon dioxid and phosphoric acid. (2) Rapid elimination of weak phosphoric acid through

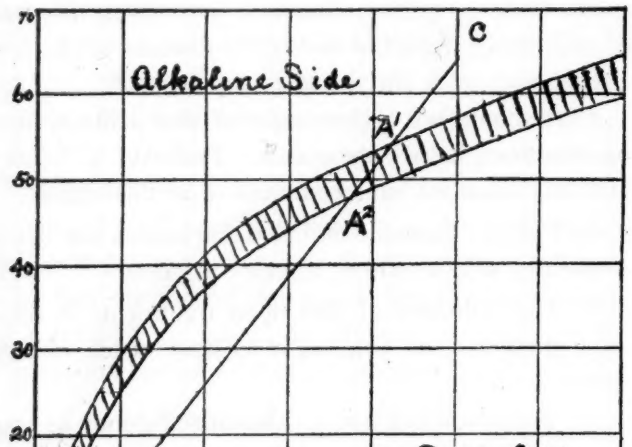

Diagram 2. The normal carbon dioxid dissociation curves of normal human blood, as we have found them, are all within the shaded areas. The figures to the left indicate the carbon dioxid content in volume per cent., those below mark the carbon dioxid tension in mm. of mercury.

the kidneys; (3) Rapid elimination of weak carbonic acid through the lungs. When an acid is added to the blood, such as strong HCl, it combines with the sodium salts and liberates carbon dioxid and phosphoric acid.

$$\text{Sodium phosp.} + \text{HCl} = \text{NaCl} + \text{phos. acid.}$$
$$\text{Sodium carb.} + \text{HCl} = \text{NaCl} + CO_2.$$

Thus, for every unit of strong acid introduced into the blood, there is liberated a unit of weak acid which possesses much less power of altering the reaction of the blood. The only danger is too much strong acid.

At the meeting of the Association of American Physicians held in Atlantic City on May 5, 1920, J. H. Means, in a paper in which he discussed the acid base equilibrium in disease, gave the two following diagrams, which expressed very clearly the points he was demonstrating. Diagram 1 is one devised and published a number of years ago by Lawrence J. Henderson. And diagram 2—the carbon dioxid diagram—is a method of presenting acid-base equilibrium factors in graphic form which was worked out by Haggard and Y. Henderson and was published by them in 1918 in the *Journal of Biological Chemistry*.

In discussing Diagram 1, Means pointed out that much trouble arose from the fact that the denominator in this diagram was not clearly separated in one's thought from the numerator. Hence much unnecessary confusion was constantly arising. He then gave Diagram 2. In this the upper line of the curve indicates the H-ion content, and the lower line of the same curve the carbon dioxid tension of the arterial blood. When both are normal they cross the line OC at points A^1 and A^2 respectively. Any marked changes in suspected normal cases would be indicated by a deviation either to the right or to the left of line OC.

FIFTH AVENUE AND ST. JAMES STREET.

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A CONSIDERATION OF ETHYL CHLORID ANESTHESIA.*

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Ethyl chlorid is a colorless, very volatile liquid of aromatic odor and sweetish taste, with a specific gravity of .9214 at 0°. Its vapor density is 2.219 as compared with air. It boils at 12.5° C. and is only preserved at the ordinary temperature and pressure by being kept in sealed containers. It is supplied in glass capsules containing 3 or 5 cc., the former suitable for children, the latter the adult dose, and in larger containers of 50 cc. fitted with a nozzle for spraying. It is highly inflammable.

It was discovered by Basil Valentine, a German Alchemist, in the fifteenth century and named by him *Vinus Sali*. Apparently its anesthetic properties were not observed at this time, at least there is no

*Read during the Joint Meeting of the Canadain, Interstate and New York Anesthetists with the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921.

record of its use for that purpose. It was rediscovered by Flourens, in 1847, who stated that it had anesthetic properties like ether, which statement was confirmed by Von Bibra and Harless from experiments on animals. It was successfully used, in 1848, by Hayfelder as a general anesthetic in the human subject. For nearly half a century it fell into disuse, being revived at the end of the last century, since which time it has increased in popularity.

SCOPE AND UTILITY OF ETHYLCHLORID AND METHOD OF USE.

Its portability, the rapidity of its action, and the length of time it permits for operative procedures make it compare well with nitrous oxid for many short operations and as a method of inducing anesthesia previous to the administration of chloroform or ether.

Although some use this anesthetic by spraying it into a more or less open inhaler or sometimes on only a piece of gauze or absorbent cotton contained in the palm of the hand and held over the mouth and nose, the method of administration is more generally by a closed type of inhaler of which numerous designs may be obtained. I have found Ormsby's ether inhaler to be very satisfactory and have used it in the majority of my cases, though I have tried several of the inhalers made solely for administering this anesthetic. In a few of the early cases I used a more or less open method which was found less satisfactory; the induction time and amount of anesthetic consumed being greatly increased thereby. The method of administration is to place a capsule in the container, the inhaler is then applied to the face during expiration and the capsule broken. The contents soon vaporize at the ordinary temperature of the operating room. If using an Ormsby inhaler the capsule may be placed in the bag and broken by the hand outside the bag, care being taken not to puncture the rubber bag of the inhaler in doing this.

The *induction period* is usually between forty and sixty seconds; in children it may be as short as twenty seconds. Consciousness disappears before this, in fact intelligent patients who have counted their respirations as far as possible can as a rule only recollect two to four respirations. The time available for operation is from forty-five seconds to three minutes; in some cases an analgesic condition remains even longer, in which apparently no actual pain is felt though the operation be continued and the lid and corneal reflexes are present. Thus resection of one or two ribs for empyema can be accomplished, in my experience, in about 90 per cent. of the cases, with one 5 cc. capsule, the final stages of putting in a drainage tube and possibly a stitch being often done with the patient in practically full control of his powers of movement, though sensation is annulled to an extent which prevents his recollection of any sense of pain. Hewitt in a carefully conducted series of cases obtained an anesthesia of forty-six seconds. Banfylde Daniels[3] gives the average induction period at forty-six seconds and the longest available anesthesia two hundred and five seconds, the shortest twenty seconds.

INDUCTION.

Owing to its rapid action when given by the closed method it is scarcely possible to distinguish the various stages of anesthesia. First there is quivering of the upper eyelids. The breathing soon becomes deeper and more rapid, remaining regular. A little later, vibratory movements of the larynx are felt by the fingers under the chin, which in a few moments deepen until the characteristic laryngeal stertor is established. About the same time that the breathing deepens the patient's color improves, the face becoming a healthy red. In some cases a light perspiration breaks out over the face. The eyeballs move at first from side to side later becoming fixed, generally in a position of convergent squint and turned either upwards or downwards. The pupils are widely dilated and do not react to light. The corneal reflex is absent. The muscles are relaxed except the masseters, which in about one-third the cases remain rigid. The features are usually flushed and a light perspiration may break out over the face and neck.

FOURTH STAGE OF OVERDOSE.

The pupils are widely dilated and fixed, eyelids separated, breathing shallow or absent, face pale, pulse weak and rapid.

The usual remedial measures are adopted, the chief artificial respiration which usually results in rapid recovery owing to the ease with which the drug is eliminated on account of its volatility.

When the operation is not upon the mouth or nose it can be commenced immediately upon the first sign of stertor, before the patient is as deeply anesthetised as has been described, the inhaler being left applied to the face a short time longer, until deep anesthesia is established. I have never seen any reflex act occur when a skin incision or puncture was made at this stage. A longer time for operative proceedures is thus obtained than when the inhaler has to be removed before the surgeon can commence his work.

In about one-thrid of the cases one meets, there is

pronounced masseteric spasm, even under deep anesthesia. This is of no consequence if the nasal passages are clear, and in fact has never given the author any trouble, except when the operation necessitated opening of the mouth. In these cases, with adults and older children, a closed gag may be inserted before the induction of anesthesia. In younger children who would be alarmed at this proceedure, a boxwood wedge may be used to open the teeth, when necessary, before inserting the gag and after the patient is anesthetised. The wedge, however, is an instrument to be used with care as loose teeth may be dislodged during its insertion. Should the patient hold his breath for a short time as sometimes happens after the first inspiration, a greater or less degree of cyanosis may occur. If no physical obstruction to breathing exists, however, this holding of the breath is nearly always of short duration, the pink color returning to the face after a few good inspirations.

There are exceptional cases where the pupil does not dilate but remains at about four or five millimeters even when the patient is quite under the influence of the anesthetic and ready for operation. In a few others the pupil may remain dilated for a short time after the reflexes have returned, in these cases any painful stimulus usually causes it to speedily assume the normal size.

This anesthetic is used sometimes for long operations, especially on the continent of Europe, but here it appears to be inferior to ether. Its greatest use is in short operations, where only five or ten cc. are required, and as a method of inducing anesthesia before ether or chloroform, especially the former. Flora Murray[4] however, giving it by an open method, has anesthetised one hundred and fifty children under one year of age for ten to fifteen minutes, for such operations as circumcision. It may also be used for extraction of teeth, opening abscesses, resection of ribs for empyema, removal of tonsils and adenoids, (where the snare operation is performed for the former, unless the operator works very quickly it is necessary to follow up with ether), removing finger and toe nails, iridectomy, injection of hip and knee joints, reduction of fractures and dislocations.

The induction period should not be excessively prolonged. Where a weak mixture of the gas and air is used, the oxygen in the bag becomes replaced with carbon dioxid and this rebreathing causes cyanosis and increases the tendency to nausea and vomiting afterwards, leaving also a greater sense of lassitude with the patient. These disagreeable symptoms are of much less frequent occurrence where the administration only occupies a short time.

AFTER EFFECTS.

These are less severe than with chloroform or ether owing to the rapid elimination of the drug. They vary with different patients, with the quantity of drug used, and the amount of rebreathing. With short administrations vomiting occurs about once in seven or eight cases. Sometimes there is headache. This is more apt to occur when the patient is allowed to move soon after the return to consciousness, than if kept in the recumbent position for half an hour after the operation. If possible the patient should receive the same preparations as for any general anesthetic, with the stomach empty, although this is not so imperative as in the case of ether or chloroform anesthesia, and short operations have frequently been performed, principally in accident cases, soon after eating. In these cases vomiting usually occurs as the patient recovers from the anesthetic, but never during induction or maintenance of anesthesia, if the drug is properly administered. The number of fatalities are about one in ten thousand[5]. McCardie[6] reports twelve thousand cases with four deaths occuring in Birmingham and district, these all being cases of operations in which no other anesthetic was used. W. E. Lee[7] reports fifty-five hundred and seventy-five cases with five deaths, but there were all bad risks. Hornabrook[8], of Melbourne, reports forty-three thousand four hundred and thirty-three administrations of ethyl chlorid and somnoform in dental, postnasal, and adenoid operations without an accident though many were given by men with slight experience of anesthetics. Many reports of two thousand to five thousand cases are on record without any fatality. At the Winnipeg General Hospital, together with the author's outside cases we have had some twenty-two thousand administrations with no deaths so far. Many of these have been administered by men with no special experience in anesthesia, especially in the earlier cases. The greater number of these anesthesias were preliminary to ether, but the patients are invariably, in these instances anesthetized to the full extent, for, if not, the ethyl chlorid is eliminated sufficiently for the patient to begin struggling and holding his breath from the irritating fumes of ether before sufficient of that anesthetic has been absorbed to place him under its influence.

ADVANTAGES AND DISADVANTAGES.

In regard to safety, which must always be the chief consideration in the use of any anesthetic, nit-

rous oxid is undoubtedly safer, but lacks the portability of ethyl chlorid. Again, unless nitrous oxid be administered with oxygen as a continuous administration, the length of available anesthesia is not so great as with ethyl chlorid.

If necessary, with ethyl chlorid, the dose can be repeated several times. In some dental cases, where a large number of difficult teeth have to be extracted, two to even three capsules may be necessary. In these cases the recovery period is somewhat more prolonged and the tendency to nausea increased, but not nearly to the extent which would be present had chloroform or ether been used for the same length of time.

PHYSIOLOGY.

As has been shown, absorption is very rapid. The quantity of ethyl chlorid contained in the blood in complete anesthesia is not nearly so constant as with chloroform. The blood contains usually about twenty-five milligrams of ethyl chlorid per hundred cc. at the moment of disappearance of the lid reflex[9]. In the course of a prolonged anesthesia the quantity in the blood varies between thirty and seventy-five milligrams per hundred cc. The fatal quantity varies greatly; one hundred and fifty to two hundred milligrams per cc. has been present in some cases, while in another case forty-seven milligrams caused death in dogs. For these reasons one cannot fix the fatal dose of ethyl chlorid in the blood. Where the induction period is slow a greater quantity of anesthetic is absorbed by the blood than where the anesthesia is rapid. This may result in a longer period of anesthesia. In some alcoholics and also in some of good habits the awakening is very rapid. This, so far, has not been accounted for, except as a matter of idiosyncrasy.

Elimination is very rapid, the arterial blood of an animal, for example, contained, at the moment of stoppage of the anesthetic and of allowing respiration of pure air, forty-two milligrams per hundred cc. One minute after it contained only seventeen milligrams; two minutes after, four point nine milligrams[10]. The lowering of the quantity proceeds a little slower in the venous blood. In the case of any obstruction to respiration, the induction or elimination is correspondingly slower.

The vapor of ethyl chlorid is absorbed by the red cells to a greater extent than the plasma. The quantity in the cells is on the average three times the quantity contained in the plasma[11]. Embley[12] found the solubility in blood at 38° C. to be over 500 per cent by volume of the vapor, double the solubility in water, which equalled 253.36 per cent at 21° C. and 760 mm. He considers that ethyl chlorid enters into chemical union with the blood. We are therefore justified in assuming of ethyl chlorid as of chloroform that the blood acts as a retaining medium for converting the irregular flow of anesthetic into a constant one.

EFFECT ON THE RESPIRATION.

The first effect of ethyl chlorid is usually to cause an increase in the rate and volume of the respiration; often, where the dose is even large enough to cause marked lowering of the blood pressure, the respirations are still increased in rapidity though decreased in volume, returning to their normal rate and extent with the elimination of the drug[13]. Now, however, if the anesthetic is pushed further the respiration is paralyzed, stopping usually from 1.5 to 3.5 minutes before the heart, the stoppage being preceded by irregular respiration. It is observed that after the respiration has been in abeyance two or three minutes it will be recommence for a short time, twelve or fifteen respirations, increasing gradually at first in extent then decreasing similarly and irregularly. This may also occur with other anesthetics. An important point is that when respiration ceases through overdose the heart is usually still in good condition so that artificial respiration—which in a drug so rapidly eliminated, speedily reduces the quantity in the blood—is nearly always effective in restoring the patient to a normal condition.

The first effect of ethyl chlorid is usually to cause paralysis as with chloroform, but the quantity of ethyl chlorid required to bring about a similar condition is nineteen times[14] that of the latter drug.

With small doses there is generally a light preliminary rise in blood pressure of a few seconds' duration, followed by a greater or less fall according to the dose administered. With large doses this fall may be very rapid and is more pronounced after section of the vagi[15] or the administration of atropin[16]. Administration of oxygen with ethyl chlorid diminishes greatly the depth and rate of fall of blood pressure, while the addition of carbon dioxid increases the rapidity of the fall[17]. A sudden fall of blood pressure occurring with large percentages of ethyl chlorid vapor is due to vagus[18] stimulation with a still larger dose it may be due also to the action on the cardiac muscle. According to Embley[19] it requires four times as much ethyl chlorid to produce vagus inhibition as of chloroform, while, as has been stated above, it requires 19 times the dose to produce the same degree of cardiac depression, therefore in-

hibition sets in relatively rapidly before much depression has occurred, or the spontaneous excitation of the heart has been too much depressed to break away from the inhibition. This fact renders it possible for recovery to take place even after a very low degree of blood pressure has been reached, in some cases, spontaneously, by removal of the anesthetic, while in others recourse to artificial respiration becomes necessary, with good results. Even under deep anesthesia, in the case of animals, continuous electrical stimulation of the vagus will not cause permanent stoppage of the heart.

When administered in excessive concentration—exalting the excitability of the vagus and vasomotor mechanism—sudden cessation of the circulation may occur[20] causing syncope, not necessary fatal. The blood contained in the venous system in this case is not charged with the anesthetic to the same degree as that in the heart and arteries. Therefore, when the circulation is restored, the oncoming venous blood filling the heart lowers the tension of the anesthetic in the myocardium, relieving it of the depression caused by the ethyl chlorid and allowing usually a very rapid recovery.

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ETHYL CHLORID GENERAL ANESTHESIA: A CLASSIFICATION OF SIGNS OF OVERDOSE AND ITS ACTION ON THE CARDIO-VASCULAR SYSTEM.*

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This report is based upon observations during the past five years with the personal use of ethyl chlorid in general anesthesia in about two thousanad cases. These were mostly for operations of from one to five minutes. About two hundred, however, were for operations lasting from fifteen minutes to one hour each. Nineteen cases carefully studied were of an average length of fifty-three minutes. Much of this work was done in France upon soldiers, where, in addition to the personal cases above mentioned, it was my pleasure to be in close contact with the application of this agent, as an inducter for ether anesthesia, in many thousands of cases.

I wish here to thank Dr. A. R. Foss, of the Minneapolis General Hospital for his valuable association in the detailed study of the nineteen prolonged anesthesias mentioned.

Most of my observations have been made upon adults in good physical condition, the majority of these, wounded soldiers in France.

I do not care to enter into a discussion of technic or of the various methods for applying this agent. However, the observations here presented, hold good in any method. In the majority of cases I used a gauze covered mask of the Yankauer type.

Ethyl chlorid in overdose produces one of two sets of symptoms. I have designated these as the *spasm type* and the *respiratory depression type.*

For the sake of clarity we will consider them separately.

SPASM TYPE.

Approximately nine out of ten of all patients overdosed with ethyl chlorid manifest this type.

The first indication of approaching spasm is a sardonic grin due to contraction of the muscles about the mouth. About the same time we notice a beginning contraction of the masseter muscles, and a beginning crowing of inspiration. This crowing due to partially obstructed inspiration, is the real warning that the dose must be reduced.

If the overdose of the drug be continued, the spasm progresses rapidly until, in about one or one and a half minutes more, it will have become a com-

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plete respiratory obstruction, and a state of peripheral asphyxia is present.

Just what muscles are involved I have not been able to determine. Generally speaking they are the facial muscles about the mouth, the muscles of the neck surrounding the pharynx and the muscles of the larynx. The masseters start to contract early, as already stated, and this contraction progresses rapidly and to a great degree. Only in the spasm of tetanus have I seen such a masseteric contraction. With this masseteric spasm well developed it is practically impossible to pry the jaws apart sufficiently to insert a mouth gag.

With the general spasm well developed, all of the muscles of the body are somewhat rigid but nothing so, in comparison with the muscles of the face, mouth, pharynx and larynx. The respiratory effort is violent.

The spasm once inaugurated develops so rapidly that cyanosis does not appear in the usuel case until the obstruction is almost total. When it appears it develops very rapidly and half a minute later the patient is black.

The rapidity of progress of the spasm is apparently in proportion to the vapor tension of the ethyl chlorid.

In all ethyl chlorid anesthesias, there is apt to be a decided dilation of the pupil during the early induction stage, which dilatation however disappears within a minute or two after the third stage of anesthesia is reached. In the spasm type, the pupil does not again dilate until respiratory obstruction is almost total; indeed I have seen cases of almost total obstruction lasting half a minute with yet no secondary dilation of the pupil. The patient's open mouth does not prevent this obstruction.

In prolonged ethyl chlorid anesthesias, this spasm may reappear as often as the patient is overdosed. In many cases, the latitude between operative anesthesia and wakefulness is so narrow, and the stage of overdose so close upon the operative stage, that it is difficult to maintain an anesthesia without many times entering the beginning of this spasm.

BLOOD PRESSURE REACTIONS.

During the spasm period the systolic blood pressure is elevated to varying degrees in different patients. I have seen the systolic pressure mount rapidly fifty mm. The highest rise occurs in about a minute following the spasm and usually the rise is proportionate to the severity and duration of the spasm. The average rise is light, or as I choose to call it, aborted spasm is from five to twenty mm.

The diastolic pressure may follow the systolic upward, it may remain stationary or it may fall as the systolic rises. The fall of the diastolic with the rise of the systolic is usually proportionate to the systolic rise, thus maintaining a level average pressure. When the diastolic rises with the systolic, this rise is usually much less than the rise of the systolic. I have seen the systolic rise 30 mm. with a rise in the diastolic of but five mm. I recall one case in which after eighty minutes of anesthesia the systolic had risen from 120 to 170 mm. and the diastolic had fallen from ninety to forty mm. Pulse pressure at the beginning was 30 mm. and at end 130 mm. This was an unusual case. Indeed cases showing this progressive equal divergence of the two pressure to any degree are unusual.

I make no further attempt at this time to analyze these varying changes in blood pressure, except to state that they have not occurred in other than spasm types where operative anesthesia and the inauguration of the spasm stage were so close together that the recurrent spasm was frequent.

The pulse rate increases during the spasm as a rule proportionately to the increase of systolic pressure.

There is a deepening of the spasm once inaugurated, for a period of a few seconds after the removal of the inhaler. This is constant, and the anesthetist knowing it will be saved some worry.

REMEDIAL MEASURES.

As for resuscitation in these cases of peripheral respiratory obstruction the problem is the same as with overdose under any other anesthetic agent, namely, the removal from the blood and tissue cells of the excess of the drug. However, in the spasm type, this is not an easy task because of the rigid contraction of the masseters. The mouth must be opened, the tongue pulled far out and vigorous chest compression made. Even with the mouth open and the tongue out, there is still a great deal of obstruction. However the rapidity of elimination of ethyl chlorid makes the resuscitation successful in the good cardio-vascular type. I have not seen a death under ethyl chlorid but in my early use of it, I have been more than once badly frightened.

With knowledge of this action there is ample warning from the beginning spasm, to avoid the more serious aspects of it by the immediate removal of the drug, as soon as the beginning spasm is noticed.

The beginner with this drug should always insert a substantial mouth gag before starting the anesthetic.

DEPRESSION TYPE.

This is a progressive central respiratory depression and occurs in approximately one out of ten of overdosed patients. From the onset, the respiratory effort grows less both in volume and in rate. The volume depression is greater than that of the rate. With the continuancee of the drug in overdose, this depression progresses to a complete respiratory paralysis in from one-half to two minutes, depending upon the patient and the vapor tension of the drug. The patiently is perfectly relaxed, in every way.

The picture during the deeper degrees of depression is one of collapse. The color is ashen: the pupils widely dilated: and the respiratory effort, if there is any at all, is quite discouraging. The picture resembles that of cardiac syscope. But the pulse belies the picture.

The pulse although slowed in rate is of good quality and regular. In fact it seems to be affected in rate only, and in cases of light depression, not even in rate.

The blood pressure does not fail, to an extent that the change can be detected by palpitation. Because of the infrequency of this type, we succeeded in finding only two, during our detailed study of the effects of this drug clinically upon the cardio-vascular system. In one of these two there was a rise in systolic of 30 mm. and a rise in disatolic pressure of 20 mm. at the time of reduction of respiration to imperceptibility.

In the other there was a rise in systolic pressure of 18 mm. and a drop in diastolic of 10 mm. at the time of complete respiratory cessation.

Clinically, in many cases of this depression, I have not found any change in pulse, by palpitation other than a moderate slowing. The greatest fall in pulse rate that I have seen was from 100 to 50, in a period of five minutes, during one minute of which, there was no respiratory effort whatever.

The normal anesthetic pulse rate re-establishes itself with the re-establishment of the anesthetic normal of respiration in any given case.

The slowing pulse rate begins with the slowing of the respiration and progresses with the respiratory depression.

As with the spasm type, this respiratory depression may repeat, during the same anesthetic, as often as the patient is overdosed. Following recovery from this depression the anesthetic may be continued as usual.

The type is constant and the character of anesthesia secured is aparently better than that secured in the spasm type.

In the depre sion type there is a marked secondary dilatation of the pupils as the depression progresses. This is not so in the spasm type.

To the observant anesthetist there is ample warning of the approach of this depression, and no need that it be carried to the degree of total paralysis of the center. However should total paralysis occur, resuscitation is simple. There is no respiratory obstruction, and two or three forceful, manual compressions of the thorax serve to eliminate the excess of the drug from about the respiratory center, and automatic respiration is re-established to carry itself to the anesthetic normal in from one to four minutes.

GENERAL OBSERVATION REGARDLESS OF TYPE.

The first stage of pupilary dilatation is more marked than with any other anesthetic. This early dilatation is of no importance. Dilatation of the pupil after anesthesia is well inaugurated does not occur except in overdose, and is then confined to the depression type.

Calling attention to previous reports of frequent cardiac syncope with ethyl chlorid, in laboratory experiments on animals, I wish to state that, clinically, in man we have not found this to occur.

It is impossible to pre-determine the type in any individual but once a type is manifested, it remains constant throughout the anesthetic. I have seen but one case in my experience which manifested both spasm and depression types during the same anesthetic and neither of the symptom syndromes were typical.

AN ANALYSIS OF THE RESULTS OBTAINED IN PROLONGED ETHYL CHLORID ANESTHESIA.

An analysis of fifteen cases, studied in detail, is herewith presented. The average length of these anesthesias was 53 minutes. The Van Slyke test of the blood before anesthetic averaged 57.4 per cent. and twenty-four hours later was 54.8 per cent.; a loss of 2.6 per cent.

Blood pressure readings showed the following averages:

Normal	Sys. 124 Dias. 82.
At start of anesthesia,	Sys. 136 Dias. 81.
At finish of anesthesia,	Sys. 133 Dias. 81.
One hour after finish	Sys. 120 Dias. 75.
Twenty-four hours later	Sys. 120 Dias. 73.

The blood pressure was sustained fairly well throughout. The best comparison in the above readings should be that pressure taken as normal, the day before the operation and that taken one hour after the operation, which comparison shows a loss in systolic of 4 mm. and a loss in diastolic of 7 mm.

The pulse readings showed the following averages:

Normal	80.
At start of anesthesia,	93.
At finish of anesthesia,	91.
One hour after the finish,	78.
Twenty-four hours later,	85.

Here the only comparison of value is the normal count as taken from the hospital chart previous to the operation and that taken at the finish of the anesthesia. This reading shows an increase in the pulse rate of 11 per minute.

The respiratory rate based upon a reading at five minute intervals throughout all cases showed an average of 29 per minute.

Although these readings in so small a number of cases cannot be of great significance, they serve to show the absence of any great digression from the anesthetic normal as established by ether or nitrous oxid-oxygen.

The above study was made on average adults undergoing prolonged but extraperitoneal surgery.

In the field of anesthesia ethyl chlorid falls third in value to nitrous oxid-oxygen and ether. I place it above chloroform in valuation.

It is applicable for short operations and for induction of ether anesthesia when nitrous oxid-oxygen are not available.

4455 CARROLLTON AVE.

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GAS-OXYGEN-ETHANESAL-CHLOROFORM COMBINED ANESTHESIA FOR NOSE AND THROAT AND ABDOMINAL SURGERY.*

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Ladies and Gentlemen:—

I wish, at the outset, to express to you my deep appreciation of the honor you have done me in selecting me to preside as your Chairman today,—an honor, let me say, that I realize is done to the Anesthetic Section of the Royal Society of Medicine of London, whose representative I am.

On behalf of my friends and colleagues of the Anesthetic Section of the Royal Society of Medicine of London, I give you hearty greetings. Be well assured that all the members of our Society, although unable to be present in the flesh, are with us in spirit, and will one and all be watching and waiting for the time when they can read the various illuminating, interesting, and instructive papers with which this Congress is pregnant.

In the great Brotherhood of Anesthetists, to which we all belong, there can be no better method of advancing our general knowledge of anesthesia, and our knowledge of each other, than by means of a Congress such as this. Here, I am told, are gathered together anesthetists from all parts of America, the Canadian Maritime Provinces and the Northwest, the Pacific Coast, the Sunny South and New England, all ready to learn from their Fellows; and those who have something new to show are ready and willing to share that knowledge with their coworkers for the good of anesthetists in particular and mankind in general.

The vast changes that have taken place in anesthesia since I first began to give anesthetics,—some twenty years ago—are so tremendous in their quantity, so wonderful in the vista they hold open to us for the future, that it would be a brave man who would predict the anesthetic position of 1941.

I am neither prophet nor seer, but I believe that we are but now enternig on to the threshold of such a knowledge of anesthesia as would have staggered our predecessors and, indeed, had they practiced the

*Honorary Chairman's Address presented during the Joint Meeting of the Canadian, Interstate and New York Anesthetists; as well as before the Nose and Throat Section of the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921. Also read before the Anesthesia Session of the A. M. A. Section on Miscellaneous Topics, Boston, June 8, 1921.

art as we know it today and hope to know it in the years to come, they would probably have been burnt to death at the stake as wizards, magicians or sorcerers.

THE ANESTHETIST OF TODAY.

The anesthetist of today is a totally different person to the anesthetist of twenty years ago. Today he has to be versed in methods unheard of, undreamed of, in those days; he must be thoroughly *au fait* with all those thousand one one points that go to the making of a good anesthetist. Gone—gone for ever, I hope, are the days when any Tom, Dick or Harry—no matter what his knowledge may be, was told off to give the anesthetic.

Let us hope, and I feel sure that you will one and all agree, that in the future the anesthetist will take his right and proper place in the profession—a place the importance of which is beginning to be realized by the surgeon and will in the near future be realized by the general public.

I hold strongly that in all matters appertaining to anesthesia, the anesthetist ought to be the advisor and helpmate of the surgeon.

THE ERA OF NEWER ANESTHETICS.

The recent work that has been done in anesthetics makes me think that we are only entering upon a new era in anesthesia, an era that holds endless possibilities.

Let me give you an instance of what I mean. During the last year, two of my colleagues on the staff of St. Bartholomew's Hospital, Dr. Mackenzie Wallis on the chemical side, and Dr. Langton Hewer, on the anesthetic side, have been working at a new anesthetic. This they have produced and given under the name of *ethanesal,* and its virtues and qualities were described by these two men at the meeting of the Anesthetic Section of the Royal Society of Medicine, in April, 1921.

I am bound to admit that Dr. Mackenzie Wallis has upset a great many of my preconceived ideas about anesthesia. He now tells us that an absolutely pure ether will not produce anesthesia; that the ether is merely a vehicle for conveying the real complex anesthetic quantity to the patient. I am not sufficiently versed in chemistry to follow him all the way, but I gather that ethanesal is a compound of ketones in which carbon dioxid and other gases are united. This ketone complex is dissolved in pure ether to the extent of from 2 to 5 per cent.

The purification of the ether is a necessary preliminary and this is carried out in two stages:

1. Oxidation of aldehydes and mercaptans by finely divided permanganate.
2. Removal of acids, peroxides and water by means of anhydrous copper sulphate.

By distillation in a special reflux condensor a remarkable pure ether is obtained. This purified product with a constant boiling point possesses remarkable properties:

1. It is not anesthetic except in very large quantities.
2. It is a cerebral excitant and persons working with it get hilariously drunk. This has happened to the writer on several occasions.

To this pure ether the ketone is added and at once its properties change:

1. It is a safe and reliable anesthetic.
2. Its action on the circulatory system lies between that of chlorofrom and ether.
3. All the irritating effects usually observed with ordinary anesthetic ethers are now lost.
4. Analgesia can be maintained for a prolonged period.
5. It is practically non-toxic. Large doses given to animals do not kill them. Rabbits have to be pithed in order to kill them after having been anesthetized for several hours. Children have been given repeated anesthetics with ethanesal with no harmful effects.
6. It does not produce either glycosuria or ketosis and does not aggravate these conditions when present.
7. In animals it is without effect on blood pressure or respiration.

The ketone complex is the agent responsible for all the anesthetic action and is non-toxic in the amount given in the anesthetic ethanesal. The pure compound ketone has been isolated and belongs to the middle of the series of ketones. Many hypnotics and analgesics owe their specific action to the ketones they contain.

In finding this ketone complex in good ordinary anesthetic ether, removing the impurities in the later, which cause all the irritating effects, and putting back the anesthetic compound, I feel that a new paragraph in anesthesia has been opened up.

Ketones are not easily oxidized and so remain even in the very bad samples of ordinary anesthetic ether and still exert an anesthetic action, although this is accompanied by all the irritating effects.

Some of the higher grades of anesthetic ether have very little anesthetic action because of the de-

ficiency of the ketone complex,—the necessary compound for producing anesthesia.

The possibilities of the new compound are unlimited. If the ketone complex is used in a proportion above 5 per cent anesthesia is very deep and consciousness is only slowly regained.

No unpleasant taste or smell follows its administration and the material itself is practically odorless and tasteless. Hence its value for children and old people and also acute cases.

Further experiments are being conducted to eliminate entirely the necessity of using ether as a vehicle and the effort is being made to substitute an entirely innocuous volatile vehicle.

And now, in approaching the subject matter of my scheduled address, let me begin by saying that I think the two great essentials for an anesthetist to keep in mind are:

1. The safety and comfort of the patient.
2. The comfort and convenience of the operator.

If we take the first (and the most important) I think that in a great many cases the safety depends on the knowledge the anesthetist has of some given method. By this I mean that it is safer for a man to use a method that he knows of, rather than to use another method, which in itself is safer, but of which he has no knowledge.

Now when we consider this question of safety and comfort of the patient we must include the preoperative, operative and postoperative periods.

PREOPERATIVE CARE.

With a little care and forethought one can do much to help the patient during the preparation before operation. In my opinion there is no need for the drastic treatment that used to be meted out prior to operation; there is no need for that starvation and severe purgation that were in vogue years ago. The patient should be on a light diet and should be given an ordinary laxative. We must remember that any operation entails a certain amount of strain on the patient; it calls for an effort on their part, and so they should not be enfeebled by starvation, purgation and enemata. I have never heard it advocated that an athlete just prior to some big contest should be starved and purged—there is no sense in it.

Of course there are a certain number of cases when it is essential to have the bowel clear, and naturally one does not include these in the above statement.

Preoperative medication has done a lot to rob operations of their terrors—and if the patients are given hypodermically some morphin and atropin, or morphin, atropin and scopolamin before the operation; they usually come to the table in a drowsy state with their mentality somewhat dulled, a great gain on the condition of years ago; apart entirely from the fact that they usually need less anesthetics.

(N. B. It is well to bear in mind that after hypodermic injections of morphin and atropin and especially morphin, atropin and scopolamin, that patients should not be allowed to walk to the theater, but should be carried.)

ADJUVANTS FOR GAS-OXYGEN ANESTHESIA.

During the last four years I have been endeavoring to find some anesthetic or mixture of anesthetics which could be used in combination with gas and oxygen, as an adjuvant to produce relaxation when necessary and in nose and throat work and to assist in the maintenance of anesthesia.

I have tried a great many mixtures, and, until the introduction of ethasesal a few weeks ago, I was using as my adjuvant a mixture of chloroform and ether of equal parts. Now I have substituted ethanesal for ether, and find that the chloroform is only needed for nose and throat work and in some of the abdominal cases.

The aim of all who have been working on this matter has been to produce a form of anesthesia which was not only safe and pleasant for the patient, and adequate for the surgeon's needs; but also was as little toxic as possible.

It must, I think, be fairly obvious that the after condition of a patient who has been operated on under gas and oxygen anesthesia ought in theory and is in practice far better than when ether or chloroform has been given, for since the nitrous oxid and oxygen are non-toxic and are quickly eliminated, the patient returns to a normal state far more readily than after the more potent and toxic drugs.

We must remember that after an ether or chloroform administration it takes some time for the drug to be eliminated from the system, and this process of elimination must add to the strain on the patient.

TECHNIC OF ADMINISTRATION.

The actual technic of the administration is quite simple and the necessary skill is readily acquired.

In 1917, when I read a paper on nitrous oxid-oxygen with regulated rebreathing in military surgery, I had not then had much opportunity for using this anesthetic for civil work, but since then I have been using it for a great variety of cases.

In 1917, I thought that nitrous oxid-oxygen was not well suited to abdominal work; but I have since been trying to form a combination of anesthetics which would give me adequate relaxation and yet would use the minimum of toxic substances. At the moment I am using as my relaxant a mixture of chlorofrom and ethanesal of equal parts, so that the anesthetic becomes a combination of nitrous oxid-oxygen-ethanesal-chlorofrom, and with this I have been producing a type of anesthesia which entails but little strain on the patient and is wholly adequate for the surgeon's needs. The actual technic I employ now is:—

The patient is given morphin, atropin and scopolamin half an hour before the operation.

Gas and oxygen is then given in the proportion of about 1 of oxygen to 10 of gas, and as soon as the breathing begins to get deep and regular the gases are allowed to pass over the surface of a mixture of chloroform and ethanesal (equal parts) so that they pick up a small amount of mixture. In a few minutes the breathing becomes automatic, with slight soft stertor, thus showing that anesthesia has been obtained. The tap on the mixture bottle is then turned back, so that the patient is only having gas and oxygen and the operation is started. The amounts of gas and oxygen must now be regulated to what the administrator thinks will be the correct amount: and this for the majority of cases is about one of oxygen to 4 parts of nitrous oxid

ADVANTAGES.

For a great number of operations it is quite unnecessary to give any more mixture as an adjuvant, and the remainder of the operation is conducted under gas and oxygen.

Given in this way the anesthesia is excellent both for patients and operator, while the after-condition is extremely satisfactory. The patients readily regain consciousness and, in the majority of cases, are not inconvenienced by nausea or vomiting.

In addition to this is the fact that they are hardly, if ever, conscious of the fact that they have had anything save gas and oxygen for they do not, as a rule, have any taste or smell of ethanesal or chloroform. This lack of smell and taste of ethanesal and chloroform carries another point worth bearing in mind. Those working in the operating theater—surgeons, anesthetist, nurses, and orderlies, do not become impregnated with the smell and odor of ether and chloroform—an important point for their own comfort.

I find nowadays using this method, that after a long afternoon in an operating theater I can leave feeling quite fresh and well, and the atmosphere of the theater never becomes charged and laden with the vapor of ether and chloroform, as it often did formerly.

The small amount of ethanesal or adjuvant that one needs with this method is sometimes astonishing to those who are unfamiliar with it, for it is quite the usual thing for only a drachm, to a drachm and a half to be used during a long operation such as the removal of a breast.

Such operations as amputation of the breast, hernias, varicoceles and the like, are quite easily done under gas and oxygen, and a very small quantity of either ethanesal or the adjuvant mixture; it is when one comes to the abdominal and nose and throat work that the difficulty begins.

For some time now many of us have been trying to get some combination to act as a really good relaxant for abdominal work.

I have been using this mixture for the last two years and have only substituted ethanesal for ether during the last three months with, I think, a great improvement, not only in the anesthesia, but also in the after-effects: and I am only now beginning to realize what a good relaxation I can obtain, and how easily it is to produce almost at will, and within a few minutes.

INTELLIGENT ANTICIPATION IN SECURING ABDOMINAL RELAXATION.

It is hardly necessary to add that, in giving this combination for abdominal work, a certain amount of intelligent anticipation is necessary on the part of the anesthetist so that the surgeon may find the abdominal wall quite relaxed when the time for sewing-up has arrived.

Assume that we are operating on a case of appendicitis. The anesthesia is deepened at the beginning, so that the surgeon may easily find the appendix and bring it outside, but when once delivered, the anesthesia need not be of a deep character and so we only give gas and oxygen. Later on, when we see that in a few minutes the cecum will be returned to the abdominal cavity and the peritoneum sewn-up, we again deepen the anesthesia by turning on the mixture for a few minutes, and directly the peritoneum is stitched-up, we can again return to gas and oxygen alone.

My experience of abdominal work, done in the manner I have tried to explain, is that the patient is infinitely better both during and after the operation

when the combination of nitrous oxid-oxygen-ethanesal-chlorofrom is given, than after any other combination or single anesthesia that I have so far encountered.

USE OF THIS COMBINATION IN NOSE AND THROAT SURGERY.

Now let me for a moment turn to the use of this combination in nose and throat work. When I first began to use this method for nose and throat work, I had nothing to guide me, so far as I knew my friend Gwathmey, of New York City, was the only man who had tried to give gas and oxygen for nose and throat work, and he had only begun, for the war cut short his work in New York City and he came over to Europe.

I will not weary you with an account of my earlier cases; many of them were failures, and it was only by sticking to it and having such a cordial co-worker in Mr. Harmer, our senior throat surgeon at St. Bartholomew's, that we have been able to evolve a technic which, I believe, to be an excellent one for this type of operation and one which is infinitely superior to anything that we have tried before.

Briefly our technic is:

1. *Premedication.*

Children none—or at most 1-200 gr. atropin. Adolescents: morphin 1-6 gr. and atropin 1-150 gr. Adults: either Burroughs & Wellcome Hyoscine, Compound "A" or "B" according to size.

Hyoscin Compound "A" contains:

Hyoscin Hydrobrom:	gr. 1-100
Morphin Sulph.	gr. 1-6
Atropin Sulph.	gr. 1-180

and Hyoscin Compound "B" contains:

Hyoscin Hydrobrom.	gr. 1-100
Morphin Sulph.	gr. 1-4
Atropin Sulph.	gr. 1-150

The injections are given half an hour before the time of operation.

The patient is then anesthetized with gas and oxygen, and the anesthesia deepened with ether or the adjuvant mixture until the breathing is deep, regular and slightly stertorous, the color should always be *pink*. The face piece is then removed, a gag placed in the mouth for such cases as enucleation of tonsils when it is necessary, and the anesthetic is continued by means of a tube placed in the mouth. Let me hasten to say that one of the astonishing things about this method is the small amount of adjuvant mixture that is necessary to maintain the requisite depth of anesthesia. Indeed, in a certain proportion of cases hardly any mixture at all is necessary for the rest of the operation,—that is to say, after the face piece has been removed; after that, as I have said, in a certain proportion of the cases gas and oxygen alone is sufficient.

DIATHERMY AND CHLOROFORM

In this connection I must mention that there is one particular type of case where I have been forced to use chloroform alone as my adjuvant. I refer to cases of *diathermy*. In our Throat Department Mr. Harmer is treating cases of carcinoma of the tongue, fauces and tonsils with the diathermy cautery, and I gather with excellent results. Now occasionally in these cases there is a certain amount of sparking—either accidental or intentional—and so one cannot have any ether in the adjuvant bottle lest there be an explosion, so one has to use chloroform.

ENDOPHARYNGEAL AND ENDOTRACHEAL METHODS.

In a large number of these cases one finds that the best way to continue the anesthesia is to pass one or two small rubber tubes through the nostrils and pass the anesthetic into the postnasal or endopharyngeal space, and I do this by means of a metal stirrup and tubes.

A still further development of this method has become necessary when dealing with certain plastic operations on the face, and with such cases as laryngo-fissure and the like.

The first occasion on which I used endotracheal gas and oxygen was on October 9th, 1918, for a case of laryngo fissure. In this case after the tracheotomy was performed, I gave gas and oxygen by means of a small catheter through the tracheotomy tube and with excellent result. Since then I have resorted to endotracheal gas and oxygen, on many occasions, for, among others, my friend Major Gilles, when he has been performing those long, tedious and splendid operations for which he is so famous.

CONCLUSIONS.

In conclusion let me say that the man who wants to give the nitrous oxid-ethanesal-chloroform combination successfully and well, must bear in mind that the patient's color must always be pink, and that he must not give the mixture for longer than is absolutely necessary.

As his skill with the method increases, so will he diminish the amount of mixture that he gives, and by that amount will his patients benefit in their condition, both during and after operation.

16 UPPER WIMPOLE ST.

EXPERIENCES WITH SYNERGISTIC ANESTHESIA.*

JAMES T. GWATHMEY, M.D., AND
JAMES GREENOUGH, M.D.
NEW YORK CITY

Much experimental work has been done by Meltzer and others with magnesium sulphate as a general anesthetic. In 1916 Meltzer and Auer[1] reported several experiments in which they used the drug intravenously on dogs with very good results. Later Meltzer and Peck[2] reported its use in three clinical cases. Apparently this work was abandoned on account of the danger to life in establishing complete surgical anesthesia with magnesium sulphate *alone*. This danger comes from the action of the salt upon the respiratory center. In saturating a patient sufficiently to produce anesthesia, inhibition of the respiration is approached very closely[3], and, although a smooth and entirely satisfactory anesthesia may be reached and recovered from, the margin of safety is so slight that the substitution of this method for those at present in use does not seem warranted.

SYNERGISTIC ACTION OF MAGNESIUM SULPHATE WITH OTHER ANESTHETICS.

It seemed to us, however, that magnesium sulphate might be combined with nitrous oxid or ether to the advantage of each. Both nitrous oxid and ether stimulate the respiration and thus oppose the most dangerous action of the magnesium sulphate. At the same time magnesium sulphate, even in doses insufficient to produce anesthesia, depresses the central nervous system and thus reduces the amount of nitrous oxid or ether necessary for anesthesia.

Although this simultaneous action of two drugs is well known, its explanation has not yet been dis covered. According to Meyer and Gottlieb, "If the weakening or the prevention of the action of one drug by that of another be called antagonism, the one-sided or reciprocal augmentation of such action may be called synergism."[4] Many examples of this action, such as the synergistic action of morphin and scopolamin or morphin and nitrous oxid or ether are well known. *It is impossible to maintain anesthesia with nitrous oxid and oxygen unless the pressure is increased to at least one and a fifth atmospheres, or unless the administration is preceded by one or another of the hypnotics, the reciprocal action of which, with the nitrous oxid completes the anesthesia.*[5]

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921.

EXPERIMENTS ON ANIMALS

With this end in view we have conducted a number of experiments with animals and have tried various combinations of these drugs in clinical cases.

As a result of our work with guinea pigs we have found that we can induce complete anesthesia, lasting from one half hour to two hours as illustrated by the following cases, which we have duplicated a number of times.

We gave a male pig, weighing 290 grams 6 cc. of an aqueous solution containing 4 grams of magnesium sulphate and 5 cc. of ether in each 100 cc. at fifteen minute intervals. The pig was completely anesthetized for 27 minutes, beginning 40 minutes after the first injection. To another pig weighing 310 grams, we gave 12 cc. of the same solution in the same manner. This animal was anesthetized for one hour and 45 minutes, beginning 38 minutes after the first injection.

I. Male Pig. Weight 290 grams.
Solution containing $MgSO_4$ 4 gms., ether 5 cc., water 95 cc.

11.25	2 cc. injected subcutaneously	Respiration	140 per min.
11.43	2 cc. " "	"	108 "
11.55	2 cc. " "	"	84 "
12.03	Completely anesthetized	"	20 "
12.30	Spontaneous motion	"	56 "
12.35	On feet and walking	"	104 "

II. Female Pig. Weight 310 grams.
Solution the same.

2.17	4 cc. injected subcutaneously	Respiration	126 per min.
2.32	4 cc. " "	"	108 "
2.47	4 cc. " "	"	80 "
2.55	Completely anesthetized	"	15 "
3.00		"	8 "
3.07		"	9 "
3.20 to 4.15	Respirations rose gradually to		17 "
4.27		"	51 "
4.33	Spontaneous motion	"	56 "
4.47	On feet and walking	"	88 "

The test used for anesthesia was a high tension spark passed through the animal from one of the extremities to the back. This always produced an involuntary contraction of the muscles but unless some motion with a muscle not on the path of the current was made, it was considered anesthetized. Both of the animals recovered and were kept over a month. They never showed ill effects, either locally, by sloughing or suppurating, or generally.

The first animal received a total of 0.83 gms. of magnesium sulphate and 1.04 cc. of ether per kilo of body weight and was anesthetized for one-half hour. The second received 1.55 gms. of magnesium sulphate and 1.93 cc. of ether per kilo and was anesthetized for one hour and forty-five minutes. We found that for one hour's anesthesia, 3 cc. of this solution per 100 gms. of body weight, or 1.2 gms. of magnesium sulphate and 1.5 cc. of ether per kilo was the best dose.

As a control we gave water and ether to one animal and water and magnesium sulphate to another in the same dosage as with the second animal mentioned above, but in neither case did we get anesthesia. We also tried giving the whole dose at one time, or dividing it into as many as six equal doses but our best results were obtained by giving it in three equal doses at fifteen minute intervals. We believe the reason for this fact to be as follows: *The ether is absorbed, or, when it is absorbed, it acts more quickly than the magnesium sulphate. It is also eliminated more quickly. If both drugs are given in one dose at the same time, the action of the ether is over before the magnesium sulphate action reaches its maximum; and the result is a succession of effects rather than a summation. On the other hand if the administration covers too long a period both drugs are being eliminated as they are absorbed, and sufficient concentration for anesthesia is never reached.*

As we are still experimenting with the intravenous administration of magnesium sulphate and ether, we will only briefly cite one example at this time. We gave a female fox terrier weighing 4.5 kilos, 75 cc. of an aqueous solution containing 4 grams of magnesium sulphate and 5 cc. of ether per 100 cc. over a period of 50 minutes. The dog was anesthetized for one hour and had a nephrectomy performed. There was a severe hemorrhage associated with the operation. After the dog was fully conscious it was chloroformed.

III. Female fox terrier. Weight 4.5 kilos.

Solution containing $MgSO_4$, 4 gms., ether 5 cc., water 95 cc.

2.08 Morphin gr. 1-6 by hpyo.

2.20 Needle inserted in leg and 25 cc. of the solution run in in three minutes. The dog's respirations increased in rate and depth and it raised its head as if alarmed, although the introduction of the needle was accompanied by no response. The needle slipped out at this point and after some difficulty was inserted in the vein of the other leg.

2.42 25 cc. of the solution run in in about 4 minutes. The dog then became unconscious and relaxed. The rate of flow was then reduced.

2.46 15 cc. run in in four minutes.

2.50 Abdomen opened. Intestines delivered, right kidney found and pedicle tied. Kidney excised. A severe hemorrhage followed from the slipping of the tie. This was finally controlled after the loss of at least eight ounces of blood.

2.55 5 cc. run in.

3.10 5 cc. run in.

3.15 Abdomen closed.

3.45 Dog conscious and endeavoring to get on feet. Killed with chloroform.

The total dose in this case was 0.66 gms. of magnesium sulphate and 0.83 cc. of ether per kilo. This was about one-half of the dose given the guinea pigs but it was given intravenously instead of subcutaneously.

CLINICAL USE OF MAGNESIUM SULPHATE FOR SYNERGISTIC ANESTHESIA.

Clinically we have used magnesium sulphate in conjunction with other drugs in 39 cases at the Presbyterian Hospital. In all the cases it was combined with morphin and chloretone. In addition to these drugs, nitrous oxid-oxygen anesthesia was used in 21 cases, ether in 1 case, nitrous oxid-oxygen-ether in 8 cases, nitrous oxid-oxygen and novocain in 4 cases and novocain alone in 5 cases.

Our series naturally divides itself into two parts. In the earlier cases we gave the magnesium sulphate hypodermatically in a 25 per cent. solution. Later we changed to a 4 per cent. solution given as a hypodermoclysis under the pectoral muscles. We have used the concentrated solution 25 times and the dilute 14 times.

The dosage of the magnesium sulphate in the concentrated series varied from 1 to 7½ grams, or from 4 to 30 cc. of the solution. Our results although promising, were not uniform and we changed to the dilute solution with a higher dose hoping that the absorption would be better.

These later cases we will discuss in detail as we feel that the results have been very satisfactory. Our routine has been as follows: Following the usual cathartics and light supper the night before operation and the one or two soap-suds enemata early in the morning, we give a 15 grain chloretone suppository two hours before operation. Fifteen minutes later we start a hypodermoclysis of 300 or 400 cc. of a sterile, chemically pure, 4 per cent solution of magnesium sulphate at a temperature of 110° F. The needles, 2 or 3 inches long, are inserted, just outside the borders of the pectorals, and are directed upward and inward between the muscles and the wall of the thorax until they reach a point parallel with the apex of the axilla. The solution is allowed to run in by gravity syphonage from a stand 3 feet above the patient. Very little pain is associated with the introduction of the needles. This may be obviated by using a drop or two of novocain in the skin. If a half-hour is allowed for the procedure there is very little discomfort from the distension of the tissues. The whole proceeding is, of course, done aseptically. We have had no sloughs or abscesses in patients or in animals using the common precautions of asepsis. Three doses of morphin of 1-8 grain each are given at 15 minute intervals, starting

one and a quarter hours before the operation. We divide the morphin in order that any idiosyncracy on the part of the patient may be detected before the full amount is given.

We gave 300 cc. to 11 of the patients and 400 cc. to 3 of them. The latter were large muscular men weighing 175 pounds or more. Eleven of the cases received nitrous oxid-oxygen and 3 of them had novocain injected into the skin or peritoneum. The diagnoses and operations were as follows:

ILLUSTRATIVE CASE REPORTS.

We will here report in brief a few of these cases as examples.

Case 1. (49063) Female, age 22. Occupation bookkeeper, admitted Feb. 11, 1921.

Summary of History: Lobar pneumonia four weeks ago. Fever and cough have persisted. The patient has had night sweats for the past four days. White count 21,000. *X*-ray shows density throughout the right side. Feb. 17, one inch of the eighth rib resected and drainage established under local anesthesia.

Operation: April 5, 8:30 a. m., chloretone suppository gr. 15. 9:00 a. m., hypodermoclysis of 300 cc. of 4 per cent $MgSO_4$; 9:15, 9:30, 9:45 a. m., morphin gr. 2-15. 10:23 to 10:40 a. m., operation. Small amount of novocain injected in the skin. Incision four inches long. Portions of the eighth and ninth ribs resected in the posterior axillary line. Opening 1 by 4 inches made in the parietal pleura. Lung freed from the chest wall by the finger and a tampon placed in the wound. Skin and muscles approximated about this. Except for vomiting a small amount of fluid in the afternoon the patient was comfortable the rest of the day and night and required no sedative. She said later that she felt the excision of the rib but that it gave her no pain.

Case 2. (46108) Male, aged 44. Occupation none, admitted April 10, 1921.

Summary of History: Has been at Saranac Lake, N. Y., for the past two and one-half years with active pulmonary tuberculosis. During the past three months has had diarrhea, colicky pain in the lower abdomen and tenderness in the right lower quadrant. Has been losing strength rapidly.

Operation: April 5, 6:30 a. m., chloretone suppository gr. 15; 7:00 a. m., hypodermoclysis of 350 cc. of 4 per cent $MgSO_4$; 7:15, 7:30, 7:45 a. m., morphin gr. 2-15. 8:40 to 10:30 a. m., operation. Resection of the lower end of the ileum (11 ft., 5 in.) and the cecum, ascending and transverse colon for tuberculous ulcers. Jejuno-colostomy. The patient was given 1 cc. of digifolin and 1050 cc. of 10 per cent glucose solution intravenously on the table, and a transfusion of 500 cc. of blood that afternoon. At 7 p. m. he was given morphin gr. 1-6. He had very little pain and no nausea or vomiting. The next day he was sitting up in bed taking full fluids. His chart for the first week is shown.

Case 3. (49913) Male, aged 31. Occupation fireman, admitted April 20, 1921.

Summary of History: Pneumonia 20 days ago. Fever has continued. Painful respiration and pain in right shoulder and right upper quadrant for six days. April 21, a catheter was inserted in the right chest by trocar and Dakinization of the cavity was started two days later. May 3, operation under colonic ether, thoractomy, resection of sixth rib and drainage.

Operation: May 17, 7:30 a. m., chloretone suppository gr. 15. 8:00 a. m., hypodermoclysis of 400 cc. of 4 per cent $MgSO_4$. 8:00, 8:30, 8:45 a. m., morphin gr. 1-8. 9:50 to 10:30 a. m., operation. Thoracotomy, intercostal incision. Thickened pleura resected from the surface of the lower and middle lobes of the right lung. Anesthesia begun with nitrous oxid alone. Oxygen increased to two liters per minute after the first ten minutes. Nitrous oxid gradually decreased to three liters per minute. Gas increased for a few minutes because the patient coughed. Nitrous oxid gradually decreased again and stopped entirely fifteen minutes before the end of the operation. Patient relaxed throughout and never conscious. The patient slept the rest of the day and most of the night, requiring no sedative.

Case 4. (49832) Male, aged 43. Occupation letter carrier, admitted April 6, 1921.

CASE 2 (46108)

Date	Respirations	Blood Pressures	Temperature	Urine	Stools	Diet	Bed
April 10	20	78	98.2°				
11	Op. 24	92-120-110	102-100°	1500 cc.	X		X
12	20	110-98	100°	600 cc.	X	full fluid	X
13	20–30	98-120	100.2°	1080 cc.	X	water	X
14	Inf. 30–24	124-104	99.2°	1000 cc.	X	full fluid	X
15	Inf. 26–24	110-92	99.2°	1510 cc.	X	full fluid	X
16	24	110-100	100°	810 cc.	X	full fluid	X

CASE 4 (49832)

Date	Respirations	Blood Pressures	Temperature	Urine	Stools	Diet	Bed
April 15	20	70-80	99.4°				
16	20–22	86-94	102.4°	900 cc.	X	full fluid	X
17	18–20	94-88	99-102°	1540 cc.	X	soft diet	X
May 6	20	68	99.2°				
7	24–20	88	100°	2550 cc.	X	full fluid	X
8	20	90-86	100°	2000 cc.	X	soft diet	X

Summary of History: Pleurisy two and one-half years ago. Thoracotomy one month later with persistent sinus since. April 15, operation under nitrous oxid-oxygen-ether lasting one hour. Thoracotomy and partial excision of the seventh, eighth and ninth ribs.

Operation: May 6, 7:30 a. m., chloretone suppisotory gr. 15. 8:15 a. m., hypodermoclysis of 400 cc. of 4 per cent $MgSO_4$. 8:15, 8:30, 8:45 a. m., morphin gr. 2-15. 9:45 to 10:42 a. m., operation. About six inches each of the seventh, eighth, ninth and tenth ribs resected. Thickened pleura over the left lower lobe removed. Nitrous oxid-oxygen anesthesia. The nitrous oxid was discontinued after the ribs were resected. Patient groaned throughout the operation although he remembered nothing afterward. Relaxation sufficient for the operator. The patient had considerable pain that evening and was given morphin gr. 1-4 at 8:20 p. m. Slept all night after medication and was in good condition the next day. The chart for the first three days after each operation is shown. This illustrates well the usual smooth reaction after operation under magnesium sulphate and nitrous oxid as compared with the recovery without the magnesium sulphate where a much higher saturation with nitrous oxid is required or the addition of ether becomes necessary.

ADVANTAGES OF SYNERGISTIC ANESTHESIA.

The patients have all arrived in the operating room well prepared for the administration of nitrous oxid. They have been quiet and apparently comfortable, breathing regularly and have been well narcotized. Several of them have gone to sleep almost at once and it was only with difficulty that they were aroused. There is practically no struggling under the anesthetic. The stage of excitement seems to be suppressed by the previous medication. During the operation they are well relaxed, in the majority of cases to the extent of a patient in the third stage of ether anesthesia. In some of the cases we have been able to stop the nitrous oxid entirely after the first half-hour, with possibly a renewal of it when the abdomen is being closed. In all the cases the ratio between the nitrous oxid and oxygen has been lower than usual. The average has been 5 liters of gas to 1.2 of oxygen and in some of the cases we have been able to maintain anesthesia with 3 liters of nitrous oxid per minute.

The recovery is as quiet as the induction. Very seldom is there any nausea or vomiting and in none of the cases has there been post-operative shock. If the operation is in the morning the patient usually sleeps all day without further medication, and frequently all night; although sometimes we have given codein or morphin late in the evening. Complaint of pain or distress during the first 24 hours is very rare. In all the cases there has been a remarkable absence of distension. Sometimes by the first day after operation and almost invariably by the second day, except in stomach cases, the patient has been taking soft diet with relish. We have had no cases of postoperative pneumonia with this technic.

CONCLUSIONS.

1. Magnesium sulphate may be combined with nitrous oxid or ether for anesthesia to the advantage of both.

2. The synergistic action of the magnesium sulphate decreases by about one half the amount of nitrous oxid or ether necessary for anesthesia.

3. Morphin, magnesium sulphate and nitrous oxid-oxygen give more relaxation than morphin and nitrous oxid-oxygen, frequently as much as with ether anesthesia.

4. With the technic described a very satisfactory anesthesia may be given with reduction or elimination of postoperative nausea, vomiting, pain, distension, pneumonia and shock.

40 EAST 41ST STREET.

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Book Review

Anesthesia and the Nurse's Duties.—By A. de PRENDERVILLE, LL.B., M.R.C.S., Anesthetist to Charing Cross Hospital With an introduction by SIR JAMES CANTLIE, K.V.E., M.B., F.R.C.S., C. V. MOSBY CO., Publishers, St. Louis, 1919.

It is a great pity that de Prenderville had to die so shortly after the publication of his latest volume. In it he has approached the subject of anesthesia from a new point of view in several directions and especially by the inclusion of the nurse's duties in connection therewith. The nurse has the charge of the preparation of the patient for the anesthetic and operation, and, more important still, she has to shoulder the responsibility of the after-care, when the surgeon and the anesthetist have departed; the postanesthetic period is often of serious import and the responsibility of the attending nurse is correspondingly great. The complications that may arise are most aptly and ably handled by de Prenderville in a fashion at once practical and scientific.

Each important operation, with the special points appertaining to the nurse's duties, is skilfully dealt with and clear directions for guidance given.

This small volume will be useful to those who, as de Prenderville did, lecture to nurses in their regular course.

American Journal of Surgery

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F. HOEFFER MCMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

JANUARY EDITORIAL 1922

1922—MEETINGS OF ANESTHETISTS—1922

There is just one way of being unusually successful in your specialty and that is by keeping informed regarding the very latest advances in the science and art of anesthesia. This information cannot be secured merely from the current literature. To get it first and at full value you have to attend the meetings of your fellow anesthetists and exchange your latest researches and clinical practices with them.

In consequence lay your plans now to attend at least one or better all of the following meetings and give the several Associations your moral and financial support by becoming a member and sending in all the prospects for membership you may know of.

The Pacific Coast Association of Anesthetists and the Section on Anesthesiology will meet with the Califorsia State Medical Society, May 15-16, at Yosemite, Yosemite Valley, California; Dr. Eleanor Seymour, Secretary, 1329 South Grand Ave., Los Angeles, Cal.

The American Association of Anesthetists and the Mid-Western Association of Anesthetists will hold a Joint Meeting, in St. Louis, May 22-24, at the Hotel Jefferson, the first three days of A. M. A. Week; Dr. F. H. McMechan, Secretary, Avon Lake, Ohio, and Dr. Morris H. Clark, Secretary, Research Hospital, 23rd and Holmes St., Kansas City, Mo.

It is expected that the Canadian Society of Anesthtists will meet early in the summer with the Canadian Medical Association in Winnipeg; Dr. Wesley Bourne, Secretary, 34 St. Mark St., Montreal, Canada.

Plans are also under way for a Joint Meeting of the National Anesthesia Research Society and the Interstate Association of Anesthetists at Columbus, Ohio, sometime in October. This will be a Conference on the Teaching of Anesthesia; T. T. Frankenberg, Secretary, 16 East Broad St., Columbus, O., and F. H. McMechan, M.D., Secretary, Avon Lake, O.

Not to interfere with the celebration of Boston's Ether Day, it was decided to postpone the placing of the Morton bust in the Hall of Fame of the University of New York until sometime in February and hold the celebration at the same time as the first meeting of the New York Society of Anesthetists in 1922. The bust of Morton is now being cast by the Tiffany Company and almost enough money has been subscribed to pay for it. However more money is needed to defray the expenses of a proper pedestal as well as the celebration itself. If every anesthetist, who has not already contributed to the Morton bust fund, will send a dollar or two to the Editor as soon as possible, the celebration can be made to promote the interests of better anesthesia and a recognition of the specialty in a splendid way.

If you have a paper of pertinent interest to present at any of the meetings do not hesitate to get in touch with the Secretaries or the Editor at once so that you can be placed on the program you desire.

If one thing, more than any other, indicates that the specialty of anesthesia is rapidly coming into its own, it was the great success of the Organization Meeting of the Mid-Western Association of Anesthetists. In spite of the financial depression and the threat of the railroad strike the attendance was large and enthusiastic. The scientific program was exceptional and the good fellowship shown at the Annual Dinner and in the entertainment of the Visiting Ladies was unbounded. The Mid-Western Anesthetists have an unlimited field of development and a brilliant future before them.

Those who know Dr. A. E. Guedel, of Indianapolis, as well as his work, will be glad to hear that the National Anesthesia Research Society presented him with a Loving Cup for Merit in Research in Painless Labor, at the Kansas City Meeting. This was an honor well deserved and it is to be hoped

that the N. A. R. S. will continue to reward meritorious research in accordance with the precedent so thoughtfully established.

Those, who have your interests at heart, are bending every energy to make the 1922 Meetings fulfill your expectations. Do your share by paying your dues promptly, joining the associations of which you are not yet a member, preparing papers for the programs and attending as many of the meetings as possible. Others can only help; you have to be successful mostly through your own efforts.

In order not to detract from the success of the Mid-Western meeting, Dr. Wm. Hamilton Long withdrew his plan for organizing a Southern Association of Anesthetists in connection with the meeting of the Southern Medical Association at Hot Springs last November. He hopes to get his organization into full swing for the late Fall of 1922. His efforts will complete the organization of the entire country, so those in the Southern States, who are interested, are urged to get in touch with him at once so that the future of anesthesia in the South may be properly looked after; Dr. Wm. Hamilton Long, Secretary, 1922 Deer Park, Louisville, Ky.

—McM.

Society Proceedings

Scottish Society of Anesthetists
American Association of Anesthetists.

POSTOPERATIVE MOBIDITY IN ITS RELATION TO GENERAL ANESTHESIA.*

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In the first place it will be agreed that the subject of postoperative morbidity is one of great importance to the anesthetist. I think, also, one is not wrong in suggesting that it is a subject which. as anesthetists, we have rather tended to neglect.

There are various reasons to account for this tendency. In order adequately to study the subject, it is necessary to come in contact with the patient before and after the operation—*before the operation* in order that one may gain some knowledge of the patient's condition and act on that knowledge as far as possible—*after the operation* so that one may note the postoperative condition of the patient, and with some knowledge of the previous condition, have the opportunity of forming judgments as to the part played by the anesthetic and as to the differing effects of the various anesthetic agents and procedures.

Facilities for supervision of this kind are not always possible in private work. In hospital work, however, there is ample opportunity for observation, of which, I fear, we have not availed ourselves as we might have done.

A more subtle difficulty is the determination of how far the general anesthesia is responsible for any morbid condition. There can, I think, be no question that the anesthetist has often been used as a scapegoat, and as in earlier days there were no anesthesia specialists, judgments of this kind were too readily accepted without due inquiry. Granted, however, that the anesthetist or the anesthetic was often unduly blamed, there can be no reasonable doubt that general anesthesia has a distinct and, in certain cases, a very marked influence on the postoperative condition.

What we as anesthetists have to do is to attempt to come to conclusions regarding the question, so that we may do our part in the way that is best in the interests of the patient.

In the following short paper I have attempted to introduce one or two aspects of this subject of Postoperative Morbidity in the hope that they may form the basis for discussion.

POSTOPERATIVE NAUSEA AND VOMITING.

Nausea with or without vomiting constitutes the most frequent morbid state. The estimations as to its frequency vary greatly; indeed, for various reasons it is difficult to obtain accurate information in a busy hospital ward. It is important, too, to distinguish between the cases in which the patient is sick immediately on recovering consciousness, and subsequently to this has no further trouble—a condition of things one sees so frequently after chlorid of ethyl anesthesia, and cases of prolonged nausea and vomiting which may well so aggravate the state of shock as to determine an unfavorable issue.

What then is the cause of vomiting? What relation has it, if any, to the reduction of the alkali reserve, and what measures can we adopt to modify its incidence?

The question as to whether postoperative nausea and vomiting have a casual relationship with acidosis is important practically. If the reduction of the alkali reserve is the cause of the nausea and vomiting, the administration of bicarbonate of soda in sufficient quantities previous to operation should obviate the condition. The reduction in the alkali reserve is in the majority of cases a temporary one. Is it sufficiently long in operation to account for the symptoms?

Reimann,[1] in discussing this question, says: "We shall not attempt to state dogmatically in our 15 per cent. of patients who showed acidosis what symptoms were due to that condition, but we can state decisively that these patients suffered more nausea and vomiting, more headache, more gas pains, and took a longer time to recuperate than did the others who showed compensated acidosis."

Experience with cases in which bicarbonate of soda has been administered as a routine measure for forty-eight hours preceding operation points fairly strongly to the presumption that the incidence of nausea and vomiting is thereby reduced.

Opinion in the meantime seems to be divided. Caldwell and Cleveland,[2] for instance, state that in their series of cases, "the postoperative course as to recovery, nausea, vomiting, and headache is not appreciably affected by the treatment."

In any case it would seem to be wise to avoid anything which will reduce the alkali reserve, and in view of the fact that an excess of alkali is easily detected by an examination of the reaction of the urine, and that, moreover, it is unlikely to occur, there seems no reason why an extensive trial should not be accorded to this method of prophylactic treatment, with a view to testing the question clinically. For the rest the prophylactic treatment would be concerned with attending to the following points:—

(1) *Preliminary dietetic preparation* of the patient, with due appreciation of the fact that both fasting and purgation tend to reduce the alkali reserve.

(2) *Preliminary administration of such drugs as morphin and atropin.*—There can be little doubt that, although the cause of the nausea and vomiting is probably of central origin, an excessive secretion of mucus and saliva must at least aggravate the tendency to vomit. Adequate administration of atropin will obviate this in the great majority of cases. Morphin also will help by reducing the amount of the general anesthetic required, and by calming the patient, will facilitate a smooth induction. It must, I think, be admitted, that in a small minority of patients, morphin does, in itself, tend to the production of nausea and vomiting.

*Read before the Scottish Society of Anesthetists, December 4, 1920. Reprinted by courtesy of the *Edinburgh Medical Journal.*

The proportion of patients with such an idiosyncrasy, however, appears to be so small, that one is justified, in view of the obvious advantages in the great majority of cases, of ignoring this possibility, unless a previous experience or a definite history has revealed it to one.

(3) *Choice of anesthetic agent.*—While this must depend on personal experience, it is generally admitted that a nitrous oxid-oxygen anesthesia, with or without the judicious addition of ether, is followed by less postoperative nausea and vomiting than is the case after the use of ether or chloroform. In my own experience chloride of ethyl is followed by sickness in a considerable proportion of cases, but it is as a rule of a merely temporary character, and takes place within a few minutes of recovery of consciousness.

(4) *Smooth administration* of the smallest quantity necessary.

(5) *Gentleness* in carrying out operative manipulations, especially in abdominal operations.

(6) *Absence of unnecessary movements* in transfer of the patient from the theater to bed.

(7) *The question of warming and moistening the anesthetic vapor.*—This question is an open one, regarding which opinions differ greatly. If it be conceded that one effect of warming the vapor is to lessen the irritation of the mucous surfaces, it may well be that nausea and vomiting are thereby lessened. In my own opinion, undue importance has been extended to this device.

POSTOPERATIVE CHEST COMPLICATIONS.

Here again there arises the difficulty of assigning its due place to the anesthetic agent.

One has to remember in the first place that patients who are old or who are of a certain type, if forced to lie in bed tend to develop congestions and edema in their lungs.

Again, one has to remember the opportunities for chilling which a patient undergoing an operation frequently encounters. There is the question of the temperature of the theater, the exposure of the body surface of the patient, the exposure to the air of coils of intestine, the fact that perspiration is sometimes profuse, and that if adequate measures are not adopted. the body heat will be used to dry the skin of the patient, the danger of chill after operation in transit from theater to bed.

It will be readily admitted that in the absence of a careful attention to detail the patient is liable to be subjected to distinct risks of chilling and depression of vitality, and that one of the effects of this, especially in a person predisposed to chest trouble, may be the development of a patch of pneumonia, or congestion, or a bronchitis. Having granted this, there can, I think, be little doubt that the anesthetic does play a part in postoperative chest conditions, and that in this connection ether is the agent most to be feared.

It is doubtful whether the administration of ether would, in skilled hands, at all frequently be followed by trouble if the careful attention to detail referred to above were regularly carried out.

Be that as it may, it would seem to be important:—(1) To hesitate before giving ether for any time to a patient suffering from or who has recently suffered from such lung trouble as bronchitis. (2) To be sure that the ether is pure and prepared for purposes of anesthesia. (3) To guard against the possibility of chill. (4) Question of warming and moistening vapor. It is doubtful if warming the vapor acts by preventing the lowering of the blood temperature to any appreciable extent. It would seem to be much more important to attend to the general warmth of the patient. It may well be, however, that warming and moistening the vapor may lessen irritation. It may perhaps be said that the clinical evidence appears to be in favor of the beneficial effects while the contention can hardly be supported on purely scientific grounds. (5) Preliminary administration of atropin. This is especially important where ether is the agent used.

GENERAL ANESTHESIA AND SHOCK.

The most important aspect of the question of postoperative morbidity in its relation to general anesthesia concerns itself with the part played by the general anesthetic in those cases in which there is a greater or less degree of shock at the time of the commencement of the operation, or in which, through the severity of the operation or a complication such as hemorrhage, shock becomes established.

It is not possible to introduce an account of the *clinical pathology of surgical shock.* Mr. John Fraser has recently contributed to the *Edinburgh Medical Journal*[3] an excellent critical review of the subject, and I content myself by suggesting that a careful perusal of this paper which gives an account of the most recent conclusions reached, will well repay anyone who undertakes it. I wish, however, to quote the general conclusions reached, and also some arrived at regarding the question of acidosis. Many of the findings herein referred to are the outcome of work carried out during the war by the Medical Research Committee, and are embodied in the report[4] which I also commend strongly to your notice.

Firstly, then, it should be noted that a mere reduction of the alkali reserve does not in itself constitute an acidosis. Such a reduction as is seen in operations in normal persons is not accompanied by any appreciable fall in blood pressure, and is soon compensated by the protective mechanisms of the body. Cannon states[4] that acidosis is present when the plasma holds less than 50 per cent. CO_2 after being exposed to an atmosphere such as is present in the alveoli and in the final air of an extreme expiration. There is then said to be an increased hydrogen ion concentration.

As regards the question of the significance of acidosis Fraser[3] sums up the conclusions reached as follows:—

(1) Acidosis in the sense of a simple reduction of the bicarbonate of the blood plasma is not the cause of shock or an important factor in its production.

(2) Experimentally in dogs it has been found that the pressure could be kept at 80mm. for an hour without a reduction of the alkali reserve. Below 60 mm.. however, a reduction always occurred. After a 20 per cent. hemorrhage a pressure of 80 mm. for an hour reduced the alkali reserve, i. e., produced an acidosis.

(3) A progressive uncomplicated fall in the alkali reserve is the result of the inadequate oxygen supply to the tissues.

(4) Oxidation of the tissues is more easily rendered inadequate by defective circulation through the capillaries than by a reduction of the oxygen-carying power of the blood or of oxygen tension in the inspired air when the circulation is kept at an efficient level.

(5) The progressive uncompensated fall in the alkali reserve is a symptom of a deficient capillary circulation and not a cause of such.

The general conclusions as to the nature of surgical shock are thus stated:—

"The essential underlying factor in the pathology of surgical shock is a prolonged and progressive fall in blood pressure.

The causes which may inaugurate the fall of blood pressure are various; some are nervous, some clinical. Hemorrhage and the absorption of toxic products from injured tissues are powerful collateral and sustaining factors in the production of shock.

Cold is probably an important factor in effecting a delay in the capillary situation, and when long continued it depresses all the body functions.

With the establishment of a low blood pressure, something of the nature of a vicious circle comes into play. The prolonged hypotension leads to suboxygenation of the body tissues, and a capillary stasis. The capillary stasis reduces the amount of circulating fluid, and the suboxygenation of the tissues results in the appearance of various toxic products from imperfect tissue metabolism. All of these collectively further reduce the blood pressure, and so the vicious circle goes on. It will continue to a fatal issue unless some link in the chain is broken and the error of the blood pressure overcome."

It has been established by many observers that operations under general anesthesia are accompanied by a rduction in the alkali reserve of the blood plasma.

Crile found that both ether and nitrous oxid produce immediate increase in the H-ion concentration of the blood

Caldwell and Cleveland[3] made observations in 123 cases and noted:—

(1) Average normal reading is between 58 to 60 per cent. carbon dioxid in blood plasma.

(2) A diminution in alkalinity in twenty-four hours prior to operation, probably due to fasting and purging.

(3) A further diminution during anesthesia of 55 to 58m.

(4) Diminished alkali reserve compensated for largely in first twenty four hours after operation.

(5) Operations under local as well as general anesthesia show diminution.

(6) Negligible difference between the various types of anesthesia as to degree of diminution. After chloroform some delay in return to normal.

(7) That a larger percentage of nitrous oxid oxygen cases have no nausea and vomiting than follows other anesthetics, although the series shows a rate of diminution equal to that of the gas and ether series.

Morris[5] reports observations which agree substantially with the above. While, however, he expresses the opinion that the administration of sodium bicarbonate before operation is a rational precautionary measure against postoperative vomiting, Caldwell and Cleveland conclude that the "postoperative course as to the recovery, nausea, vomitnig, and headache is not appreciably affected by treatment with alkali."

Reimann[1] states that in his opinion in 80 to 85 per cent. of the run of operated cases a compensated acidosis results from anesthesia, an uncompensated is from 15 to 20 per cent.

In a series of cases reported by Cannon,[4] of men operated upon whose carbon dioxid capacity was below 50 per cent. at the time of operation, or below it at the end of anesthesia, "the average drop in carbon dioxid capacity at the end of operation was twice as great as that reported by Caldwell and Cleveland in ordinary civil cases. The fall was greater, too, the lower the original capacity. In other words the more marked the acidosis, the more sensitive is the patient to operative procedures, and the more likely is he to be let down by them into a region of danger. Also there was a striking fall of blood pressure as the result of operation in these cases.

In experience with patients in whom the decrease of carbon dioxid capacity as the result of operation did not extend below 50 per cent. (i. e., where there was no true uncompensated acidosis), no noteworthy alteration in the blood pressure occurred.

This ominous sinking of the blood pressure has been repeatedly seen during operation on shock cases in which the alkali reserve was not determined."

Briefly summarized:—

(1) Operation under anesthesia is accompanied by a reduction in the alkali reserve of the plasma. This does not necessarily constitute an acidosis, and in the ordinary course of events is not accompanied by any noteworthy or continued fall in blood pressure.

(2) In cases of genuine acidosis, operation under anesthesia is accompanied by a big drop in the carbon dioxid capacity; the lower the original capacity the bigger the drop, the more rapid the fall, the more serious the condition. There is also as the result of the operation a striking fall in the blood pressure which is the fundamental factor in shock.

The important questions which we, as anesthetists, have to consider are:—

(1) Does the anesthetic contribute to this result?

(2) Does one anesthetic agent contribute to it more than another?

(3) What steps can the anesthetist take to minimize any deleterious effect which the anesthetic produces in these cases,

The answer to the question as to whether the anesthetic is responsible for. at any rate, some of the ill effects following operation in shocked cases, will be based partly on experimental evidence with anesthetics, in the absence of operation, and partly on the observation of results following the administration of different anesthetic agents in operation on shocked patients.

If uniformly better results are obtained in shocked cases after the use of one agent than after the use of another, then it is obvious that the anesthetic does contribute in some way to the ill effects prone to be experienced after operation in such cases.

Moreover the study of a sufficient number of cases ought to give us an approximate idea as to how much of the evil effect following operation in shocked cases is due to the operation and how much to the anesthetic.

Cattell[6] summarized as follows the main points of a research carried out by him first in France during the war, and later at the Harvard Physiological Laboratory:—

(1) Ether given to the normal animal caused merely a temporary and brief fall in blood pressure followed by a return to normal. In shocked animals, however, there is a marked sensitiveness to ether, a marked and continuous drop in blood pressure being produced by the same degree of anesthesia which in the normal animal does not interfere with the blood pressure.

(2) Increased sensitiveness to ether is brought about by any circumstances which tend to depress the general condition of the animal, e. g., low blood pressure, hemorrhage, severe operation or the injection of acid into the circulation.

(3) In the shocked animal, sensitive to ether, nitrous oxid-oxygen may be given so as to produce the same degree of anesthesia produced by ether without causing a fall in the blood pressure.

Crile,[7] testing the point experimentally, found that under approximately equal trauma the changes in the brain cells were approximately three times as great under ether as under nitrous oxid-oxygen anesthesia. Whatever view one takes of the brain cell changes referred to, it is justifiable to take them as an index of the blood pressure in the brain. Crile also found that the fall in blood pressure was on the average two and a half greater under ether than under nitrous oxid-oxygen, and finally that the condition of the animal was worse after trauma under ether than after equal trauma under nitrous oxid-oxygen anesthesia.

He concluded, therefore, that while the brain-cell changes resulting from a surgical operation are not due to the inhalation anesthetic *per se*, yet their extent is to a considerable degree determined by the anesthetic which is used. As these changes are less marked under nitrous oxid-oxygen than under ether, the former should be the anesthetic of choice.

Cannon,[4] in the summary of his paper on acidosis in cases of shock, states that "operation on men suffering from shock and acidosis results in serious and rapid sinking of arterial pressure when it is already low, and a marked and sudden decrease in the alkali reserve of the blood when that reserve is likewise already low. This change may not occur if nitrous oxygen-oxygen anesthesia instead of ether is employed but that anesthetic affords no guarantee against the ominous decline."

If one accepts these findings one is justified in concluding:—

(1) That the anesthetic *per se* is capable of adversely affecting the condition of the patient in operative procedures on shocked patients.

(2) That the choice of the anesthetic agent used may be a matter of importance. The latter conclusion involves the question of the superiority of nitrous oxid-oxygen anesthesia in such cases, at any rate over such general anesthetics as ether and chloroform. Moreover, as in any given case of operation under general anesthesia, we cannot be sure that such factors as hemorrhage, prolonged operation, or abnormal chilling may not convert a so-called normal case into a more or less shocked one, the further question arises whether in routine operative work nitrous oxid-oxygen should not be the anesthetic of choice.

Experimental work, and the experience of those who have given the method of nitrous oxid-oxygen anesthesia an extensive trial suggest at least a strong probability that this question must be answered in the affirmative.

In considering a quesion of this sort, it is the part of wisdom to be on one's guard against prejudices which are likely to be operative. Amongst these may be mentioned the regrettable fact that in this part of the world, at any rate, the facilities vouchsafed to one for any extensive trial of nitrous oxid-oxygen in hospital practice are at present conspicuous by their absence. Again in private work the apparatus which has to be transported from one home to another is somewhat cumbersome, the gas is expensive, and the method is not as a general rule sufficiently appreciated by surgeons to make adequate remuneration an easy matter. These points are noted not as arguments against the use of the method, but as prejudices to be guarded against in coming to a decision.

As a result of the consideration of the points deduced in this short paper and of my own personal experience. I cannot help believing that any one who learns to use nitrous oxid-oxygen efficiently will become more and more convinced of its advantages over such anesthetics as ether and chloroform, and will desire to use it not merely in specially selected cases, but in all cases in which there is no special contraindication.

It is well, too, to bear in mind the increased postoperative comfort and freedom from postoperative vomiting and malaise which undoubtedly follow the administration of nitrous oxid-oxygen as compared with ether or chloroform in the majority of cases.

It may not be out of place at this stage to call attention to a point which is perhaps not sufficiently appreciated, namely, that whatever anesthetic be used, the depths at which the anesthesia is maintained should never be greater than that consistent with the requirements of the surgeon and the safety of the patient. This is one of those points in which the co-operation of the surgeon and the anesthetist is so essential. Surgeons vary greatly in their demands upon the anesthetist in such a question as the amount of relaxation necessary in abdominal operations, and it is desirable that they should not be too exacting in this respect.

PROPHYLACTIC MEASURES.

In conclusion we must consider various prophylactic measures which aim at reducing postoperative morbidity, in the cases under consideration:—

Firstly, we must remember the importance of the emotional factor in producing shock.

Anyone who has read Cannon's work on *The Bodily Changes in Fear, Hunger, Pain. and Rage,* will realize what a profound effect such emotions as fear and pain may have on the secretions of the body. Biologically considered such effects are protective, but in the abnormal conditions of a patient about to be operated on, this result on the patient may be very harmful. Crile[7] was among the first to emphasize the importance of the emotional factor, and to insist on the necessity of avoiding its operation as far as possible.

The treatment aimed at accomplishing this is simple enough, and consists in a general way of reassuring the patient, treating him with gentleness and consideration, and in dulling his sensibility by such drugs as morphin and scopolamin As Crile put it, "No detail is too petty."

To minimize postoperative discomfort especially in abdominal operations, Crile injects hypodermically at some distance from the wound quinin-urea hydrochlorid one-sixth to one-half per cent. solution. The effects of this local anesthetic last for several days, so that by its use the patient is protected from noci-impulses from the operative field until the healing process has well begun.

Fasting and purgation are to be avoided.

Caldwell and Cleveland[2] found that "with rare exceptions cases receiving no sodium bicarbonate before operation showed a lower carbon dioxid tension in the specimen taken immediately before the anesthesia as compared with the specimen taken the day before. This undoubtedly is due in part to their fasting state, dinner the evening before and breakfast on the morning of the operation having been omitted, and in part possibly to the preliminary catharsis."

As fasting and purgation are, within limits, desirable, a compromise will be effected by the preliminary exhibition of alkali.

Preoperative administration of bicarbonate of soda. Apart from the above reason, and also for the possible influence on the tendency to postoperative nausea and vomiting, there is ample evidence that the administration of sodium bicarbonate previous to operation reduces the danger of operation in shocked patients, and, moreover, may act as a preventative to the development of shock. In a paper contributed to the Medical Research Committee's report on "The Preventive Treatment of Wound Shock"[4] by Cannon, Fraser, and Lowell, this question is fully dealt with. They conclude that (1) "The acidosis which prevails in cases of low blood pressure is associated with such sensitization of the body that surgical operation may result in a serious increase of the acidosis and a perilous sinking of the blood pressure. The question as to the casual relation between the low blood pressure and acidosis has been discussed, and it appears that the two conditions may interact, each contributing to the development of the other. Under these circumstances, advantage would be gained by protection against each of the conditions, first against the development of the sensitizing acidosis, and secondly against the increase of acidosis and the further fall of blood pressure which occur at operation."

(2) By the preoperative administration of sodium bicarbonate the alkaline reserves of the body can be greatly increased even in unfavorable circumstances. Since acidosis develops in shock and involves a definite risk when operation is undertaken, its avoidance should be sought. The recommendation is offered that wounded men be provided with a warm drink containing a drachm of 4 grams of sodium bicarbonate at suitable relay posts on their way from the front to casualty clearing stations.

Further, when an alkaline injection is given at the start of an operation "it prevents the dangerous depressive effects which the anesthetic and operative procedures have on cases of shock with acidosis. The operation ends not with an increase of the existent acidosis, but with the acidosis overcome and a normal alkaline reserve provided, and the blood pressure instead of being lowered is actually raised during the critical period. The blood pressure may fail to some extent later, but the improved state of the patient during operation is unmistakable, and the subsequent course of shock cases operated on with the precautions described above have been highly gratifying."

In a later paper in this series on acidosis and shock, the writer says that, "With regard to the measures for restoring an efficient circulation, certain points may be noted: Transfusion of whole blood is probably the measure likely to have a successful result in the largest proportion of cases, provided its application is not unduly delayed. . . . In a large proportion of cases, infusion of gum saline solution will be almost as effective."

A full discussion of these questions will be found in the report of the Medical Research Committee.

Reference has already been made to the deleterious effects of chilling, and to the necessity of gentleness in manipulative operative procedures. The former is only to a limited extent within, the latter entirely, beyond the sphere of influence of the anesthetist, but the importance of attending to both points cannot be exaggerated.

In concluding this somewhat concentrated survey of a large subject, I would like to stress the paramount importance of a close co-operation between the surgeon and the anesthetist.

3 HILLSIDE CRESCENT.

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AMERICAN ASSOCIATION OF ANESTHETISTS—NINTH ANNUAL MEETING, BOSTON, JUNE 6-8, 1921.

The American Association of Anesthetists held its Ninth Annual Meeting at the Hotel Bellevue, Boston, June 6-8, 1921.

Dr. Jos. E. Lumbard, New York City, the President was in the chair.

During the preliminary Executive Session the minutes of the previous meeting and the report of the Secretary-Treasurer were accepted as read.

The following members of the allied professions were elected to membership: Drs. E. E. Allgeyer, New Orleans; J. W. Armstrong, Montreal; Paul Appleton, Providence, R. I.; J. B. Barker, Piqua, O.; E. Roy Bier, Winnipeg; C. W. Blagden, Sanford, Maine; T. Craig Burns, Buffalo; Earl C. Carhart, Hutchinson, Kan.; P. P. Chase, Providence, R. I.; C. N. Chipman, Washington, D. C.; S. C. Clemans, Gloversville, N. Y.; D. F. Downing, East Orange, N. J.; W. G. Defries, Toronto; J. P. Graham, Springfield, Mass.: A. B. Graves, Buffalo; J. I. Gifford, Kingston, N. Y.; C. T. Haines, Utica, N. Y.; J. W. Hallberg, Kansas City; R. B. Hammond, White Plains, N. Y.; O. E. Haney, Portland, Maine; W. H. Harrington, Kansas City; H. M. Hazelton, Lancaster, O.; H. P. Hoffman, Buffalo; C. W. Hyde, Washington, D. C.; M. V. Kahler, Indianapolis; H. Krause, Chicago; E. H. Lane, East St. Louis; D. R. MacLean, Stamford, Ct.; Wm. deB. MacNider. Chapel Hill, N. C.; H. H. Miltimore, St. Johnsburg, Vt.; John Morgan, Rochester, N. Y.; E. A. Peebles, Wilmington, O.; Maxwell Quackenbos, Nyack, N. Y.; A. L. Reich, Newark, N. J.; A. E. Rives, East St. Louis; Edith M. Ross, Winnipeg; C. H. Sanford, New York City; J. A. Saunders, Clifton Springs, N. Y.; Emil Specht, Brooklyn; H. M. Stein, Patterson, N. J.; Mary A. Sweeney, Nashua, N. H.; W. F. Temple, Jr., Boston; W. D. Webb, Hackensack, N. J.; Wm. Webster, Winnipeg.

The following officers were elected for 1921-22: Drs. Isabella C. Herb, Chicago, President; David E. Hoag, Pueblo, Colo., and Everett A. Tyler, Philadelphia, Vice-Presidents; F. H. McMechan, Avon Lake, O., Secretary-Treasurer; Members of the Executive Committee, Drs. George Piness, Los Angeles, and Ansel Caine, New Orleans.

The Anesthetists were welcomed in behalf of the profession of Boston and New England by Dr. Frank Lahey.

During the first Scientific Session the following papers were presented and discussed:

The Present Status of Anesthesia, (Presidential Address), Joseph E. Lumbard, New York City.

Preoperative and Postoperative Treatment of Diabetic Patients, Max Kahn, New York City.

Surgical Anesthetics in Relation to Diabetes, Reginald Fitz, Rochester, Minn. Discussion—Albert Hornor, Boston.

Paroxysmal Tachycardia as an Occasional Upset during Anesthesia, Samuel A. Levine, Boston.

The Effect of Ether on the Sino-Auricular Node or Primary Pacemaker of the Heart, B.H.Schlomovitz,Milwaukee.

Postoperative Lung Complications, E. C. Cutler, Boston.

Postoperative Mussive Lung Collapse, F. A. C. Scrimger, Montreal.

During the second Scientific Session the following papers were presented and discussed:

Some Studies of the Blood before and after Etherization by the Drop Method, Mary Gage Day, Kingston, N. Y.

Synergestic Analgesia, J. T. Gwathmey and J. Greenough, New York City.

I. A Study of the Anurias Occurring in Normal Animals during the Use of General Anesthetics.

II. A Preliminary Study on the Relation between the Amount of Stainable Lipoid Material in the Renal Epithelium of Animals of Different Age Periods and in Naturally Nephropathic Animals with the Susceptibility of the Kidney to the Toxic Effect of the General Anesthetics, Wm. deB. MacNider, Chapel Hill, N. C.

The Alkali Reserve in Experimental Shock, Bernard Raymund, Columbus, O.

Blood Chemistry in Relation to Operation and Anesthesia, Victor Myers and R. Killian, New York City.

On Tuesday morning Anesthesia Clinics were held in the Massachusetts General, Boston City, Deaconess and other Hospitals and local as well as visiting anesthetists demonstrated routine and newer methods of anesthesia.

The old amphitheater in the dome of the Bulfinch Bldg., where the first operation under ether was done was opened for inspection and the relics of that event were on exhibition and Dr. J. Collins Warren, whose grandfather performed the first operation under ether in the Massachusetts General Hospital, made a few remarks of historical interests.

The following papers were presented during the Symposium on the use of Various Methods of Analgesia and Anesthesia in Obstetrics:

Selective Anesthesia in Obstetrics, Edward P. Davis, Philadelphia.

Nitrous Oxid in Obstetrics, Paul Appleton, Providence, R. I.

Local and Combined Anesthesia in Obstetrics, F. C. Irving, Boston.

Anesthesia for Dystocia, C. Henry Davis, Milwaukee.

During the Scientific Session devoted to general considerations the following papers were presented:

Observations of an Anesthetist, Boris Rapoport, Dorchester, Mass.

The Limitations of Nitrous Oxid-Oxygen Anesthesia, Ben Morgan, Chicago.

Anesthesia in Children, Edward W. Beach, Philadelphia.

Properly Given, Is Chloroform the Dangerous Anesthetic Represented? Ralph P. Beebe, Kalamaoo, Mich.

A Universal Anesthesia Inhaler, Charles H. Sanford, New York City.

The American Medical Association, through the Council on Scientfic Assembly, granted the Anesthetists an Anesthesia Session in the Section on Miscellaneous Topics which was held on Wednesday afternoon in Mechanics Hall with the following in charge: James T. Gwathmey. New York City, Chairman; E. I. McKesson, Toledo, Vice-Chairman, and F. H. McMechan, Avon Lake, O., Secretary. The following papers were presented:

Current Progress in the Science and Practice of Anesthesia, (Chairman's Address), James T. Gwathmey, New York City.

The Acapnia Theory—Now, Yandell Henderson, H. Haggard, New Haven, Conn., and R. C. Coburn, New York City.

Nitrous Oxid-Oxygen C.-E. Anesthesia for Nose and Throat and Abdominal Surgery, H. E. G. Boyle, London, England. (Official Representative of the Anesthetic Section of the Royal Society of Medicine.)

Anesthetic Units of Measurements, A. H. Miller, Providence, R. I.

How Anesthesia Can Aid and Protect Surgery, E. I. McKesson, Toledo, O.

Clinical and Experimental Researches on the Reflex Effects of Ethyl Chlorid in Anesthetic Dosage in Man, Arthur E. Guedel, Minneapolis.

The Annual Dinner was served in the banquet room of the Hotel Bellevue on Monday evening. Dr. Lumbard welcomed the guests and members, after an enjoyable dinner he introduced Dr. McMechan as Toastmaster. After-dinner talks were given by Dr. S. Adolphus Knopf, New York City; Dr. H. E. G. Boyle, London, England; Mr. Wm. H. Morse, Boston; and Dr. H. Edwin Lewis, New York City. Mrs. A. H. Miller graciously entertained with exquisit vocal selections.

Dr. Knopf suggested the advisibility of celebrating Morton's First Demonstration of Ether Anesthesia by placing a bronze bust in the niche of the Hall of Fame assigned him by the electors. It was decided that the Associated Anesthetists would do this on the Diamond Jubilee Anniversary in October.

As a compliment of the efforts of the Secretary-Treasurer in behalf of the Association and the specialty during the past year, Drs. Piness and Caine of the Executive Committee and

others present raised and presented him with a purse of $1,000.

During the final Executive Session the dues of the Association wese raised to $5. Also the following resolution, presented by Dr. Cline N. Chipman, Washington, D. C., after discussion, was adopted:

BE IT RESOLVED, That in the future no member of the American Association of Anesthetists shall instruct any undergraduates, nurse or orderly, in the art of anesthesia with the intention of granting them a certificate or diploma qualifying them as competent anesthetists.

BE IT FURTHER RESOLVED, That nothing in this resolution shall effect the instruction of medical students in regular medical schools or teaching hospitals or the routine teaching of nursing.

The Association adjourned to meet the first three days of A. M. A. Week in St. Louis, May 22-24, 1922, at the Hotel Jefferson.

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(To be continued in April issue)

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National Anesthesia Research Society
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THE PRESENT STATUS OF ANESTHESIA AS A SPECIALTY.*

JOSEPH E. LUMBARD, M.D.,
NEW YORK CITY.

There would seem to be no more fitting time for taking stock of the specialty of anesthesia than this, the Diamond Jubilee Year of the Discovery of Ether Anesthesia, and certainly no more appropriate place than Boston, in which to discuss the future of the specialty, since it was here that surgical anesthesia was given to humanity and made a routine practice for relieving pain in operative procedures.

While anesthesia was slow in developing as a specialty in the United States, quite the contrary was true of England. Great Britain had the advantage of having had John Snow to establish anesthesia as a specialty within ten years after Morton's initial demonstration, and Snow was followed by a long line of highly qualified experts who established the old London Society of Anesthetists, which, more recently, has become the Anesthetic Section of the Royal Society of Medicine.

The first organized effort to bring anesthesia into its own in the United States was the founding of the Brooklyn Society of Anesthetists by Dr. A. F. Erdmann, which has since become the New York Society of Anesthetists.

Our own society, The American Association of Anesthetists, was organized in 1912, at Atlantic City, N. J. When originally founded it was anticipated that the A. M. A. would make the American Association of Anesthetists its Section on Anesthesia, but so far this has not been done, although during the present meeting another effort to accomplish this result and to secure this well-merited recognition, is being made, and an Anesthesia Session of one-half day has been accorded. The American Anesthetists have served a long and faithful apprenticeship and it is hoped that this evidence of interest and stability will go far in convincing both the Council on Scientific Assembly and the House of Delegates of the A. M. A. of the earnestness and worth of those who are appealing for a Section on Anesthesia. In view of all that has been accomplished recently in advancing the science and practice of anesthesia and analgesia, as well as in the organization of the specialty in many regional societies and in the development of its literature, it would seem that the American Anesthetists are asking little more than they deserve in appealing for a Section on Anesthesia in the A. M. A., and in view of the election of Morton, the anesthetist, to the Hall of Fame, it would be a most appropriate courtesy for the House of Delegates to establish a permanent section during this Boston meeting. In passing I cannot refrain from alluding to the fact that Dr. John Collins Warren, the son of the famous surgeon who operated under Morton's first public etherization, is celebrating this auspicious occasion with us.

To delve into the present status of anesthesia as a specialty and to provide a basic foundation for my Presidential Address, a questionnaire was sent out to between two and three hundred specialists in anesthesia. My object and purpose in sending out this questionnaire was to find out what was actually being done in anesthesia at this important milestone in the evolution of the specialty. Over 130 anesthetists favored me with answers to my questionnaire worth compilling. The questions and answers to the questionnaire are given in sequence:

Question 1.—How many years have you been known as an anesthetist? *Answer.* The average time was 10 years and the replies ranged from 2 to 35 years.

Question 2.—About how many general anesthesias have you administered? *Answer.* The average number of anesthesias given was 9,000 plus, the replies ranging from 1,000 to 80,000. The total number of anesthesias reported from all replies was 1,250,000.

Question 3.—Are you anesthetist to any hospital? *Answer.* Of those replying 103 have hospital positions, 27 have not. All anesthetists should have hospital connections of some sort or other.

Question 4.—Do you instruct students, internes or nurses? *Answer.* Seventy instruct internes, 48 instruct students, and 38 instruct nurses. Many report that they instruct nurses under protest, but are compelled to do so in order to hold their positions with certain surgeons and hospitals.

Question 5.—Do you belong to any Society of Anesthetists? *Answer.* All reported membership in one or more societies, except 4. It should be noted, however, that while most anesthetists belong to their societies, many more should attend the meetings for the benefits they would derive.

Question 6.—Name the anesthetics and methods used by you in their order of frequency. *Answer.*

Order of Frequency	Ether	Chloroform	Gas-Ether	Gas-Oxygen	Ethyl Chlorid
1	32	3	11	14	1
2	22	6		16	6
3	9	14		8	11
4	3	12		2	6
5		1			1

*Presidential Address presented during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921.

Question 7.—Do you administer ether by the open or closed method so-called? *Answer.* Use of the open method was reported by 108, and use of the closed method by 56; many using both methods.

Question 8.—How often do you find it necessary to supplement nitrous oxid-oxygen with ether? *Answer.* Fifty per cent of those replying find it necessary to add ether, while 10 per cent make the startling admission that they never use nitrous oxid.

Question 9.—Do you employ any of the following methods, *Answer.*

Endopharyngeal	82
Oxygen-ether vapor	65
Colonic	52
Anocithesia	42
Endotracheal	37
Spinal	9

Twenty of those replying do not use any of these special methods.

It is very evident that the endopharyngeal is fast supplanting the endotracheal method and justly so as it is simpler and safer. Ether-oil colonic anesthesia is gaining, and anocithesia losing in popularity. Oxygen-ether vapor is being used quite extensively.

Question 10.—When do you use chloroform? *Answer.*

33 rarely do.
27 never do.
14 use it in alcoholics.
10 to relax.
10 in obstetrics.
8 when cautery is used in oral surgery.
8 in throat cases.
7 in brain cases.
6 in tuberculosis.
5 in children.
3 in the obese and aged.

It would seem that chloroform is less popular, but has its place.

Question 11.—Do you use any of the following anesthetics? *Answer.*

64 use ethyl chlorid.
17 use anesthol.
11 use somnoform.
12 use A. C. E. mixture.

Most anesthetists are omiting the alcohol, showing the trend of the times. Ethyl chlorid is used much more than the other combinations and mixtures. When better understood it will be more popular.

Question 12.—Do you use heat with any anesthetic? *Answer.*

81 do in some form.
49 do not.

However useful heat may be in connection with anesthesia, we must be mindful of the associated danger connected with explosions.

Question 13.—Do you take blood pressure readings? *Answer.*

99 do at times.
39 as a constant routine.
31 never do.

Question 14.—Do you keep an anesthetic chart? *Answer.*

102 do to a more or less extent.
28 do not.

I am sure that the large majority of us could and should do better work in this very important matter of keeping charts.

Question 15.—Do you examine the patient before administering the anesthetic? *Answer.* All do or know in advance that it has been done. It is my impression that such examinations are often done hastily and superficially. More care in this particular would surely bring its reward. Just getting acquainted with the patient before operation is a great advantage to all concerned. Too much interest cannot be shown the patient before the operation. Many a life could be saved by even a half way examination or the timely use of the breath holding test to determine the fitness for taking an anesthetic.

Question 16.—What preliminary medication do you use? *Answer.*

108 use morphin and atropin, alone or in combination.
16 use scopolamin.
5 use pantopon.
4 use H. M. C.
1 uses veronal.

Morphin and atropin, alone or combined, are becoming more or less of a routine preliminary, with a tendency to larger and divided doses. Scopolamin and pantopon are less popular than formerly. Synergistic anesthesia is on trial and it is too early to report on it.

Question 17.—Do you select the anesthetic? *Answer.* 117 do, and 13 do not. The anesthetist cannot do himself justice if he does not select the anesthetic, and he cannot command respect as a specialist if he does not.

Question 18.—Do you bill the patient direct? *Answer.* 110 do and 20 do not. Many wonder why this somewhat unusual question is asked. The anesthetist must have business backbone enough to collect his own fee. It is better to do so for many reasons, and more especially because the anesthetist collects

more money, the patient knows what service he is paying for and the anesthetist's identity is not lost.

Question 19.—Under what circumstances do you charge an extra fee?

Answer.

62 for extra time, going out of town, etc.
41 when patients are in easy circumstances
27 when extra skill is required
12 for night service
10 for gas-oxygen anesthesia
10 never charge an extra fee
5 did not answer
4 are satisfied with $10
1 thinks $5 is enough
1 charges extra for spinal anesthesia
4 for Sunday service.

Time, skill and the circumstances of the case and patient seem to be the rational basis for extra fees. A timely word from the surgeon or family physician explaining the value of expert anesthetic service helps a great deal in securing proper fees, especially when the bill is rendered separately and is endorsed by the operator or the family physician.

Question 20.—What operations do you consider difficult to anesthetize for? *Answer.*

Gall bladder	30	Kidney	10
Head cases	28	Brain cases	11
Tonsils, adult	21	Prone posture	8
Upper abdomen	30	Laminectomies	5
Goiter	16	Empyema	9
Chest	15	Very obese	5
No answer	7	None difficult	2

Possibly in the next 75 years of progress that degree of perfection will be reached in which no cases will present difficulty under anesthesia.

Question 21.—What operations do you consider it easy to anesthetize for? *Answer.*

Extremities	21	No answer	28
Pelvic	10	Appendicitis	10
Hernia	12	Breast	8
Mastoid	10	Tonsil, child	8

Question 22.—What anesthetic would you use for the following conditions? *Answer.*

	Ether	Gas-Oxygen	Chloroform	Local
A. Ludwig's angina	46	26	10	20
B. Tonsil, adult	85	22	6	19
C. Brain tumor	79	23	2	14
D. Empyema	37	55		34
E. Toxic Goiter	35	49		17
F. Pharyngeal Abscess	34	25	12	22

The tracheal tube should always be on hand during operations for Ludwig's angina. Many deaths are reported under anesthesia in cases of angina, toxic goiter and pharyngeal abscess.

Question 23.—What anesthetic would you use when confronted with the following conditions? *Answer.*

	Ether	Gas-Oxygen	Chloroform	Local	
A. Diabetics	26	89		80	
B. Asthma	42	52	16		
C. Acidosis	42	80			
D. Pertussis	43	40	21		
E. Hiccough	61	23	11		
F. Obesity	75	29	10		
G. Alcoholism	78	16	19	Ethyl Chlorid	5

Question 24.—Have you ever had any of the following conditions appear after the administration of a general anesthetic? *Answer.* A. Emphysemtous condition of the skin. 22 reported this condition making an incidence of one in 56,000 administrations. B. Parotiditis. 34 instances have been noted or 1 in every 36,000 administrations. C. Melancholia. 32 such complications were reported 1 in 40,000 administrations. D. Neuritis? 15 cases were reported or 1 in 82,000 administrations. E. Heart block? 9 instances were reported or 1 in 120,000 administrations. F. Pressure paralysis? 52 cases were reported or 1 in 24,000 administrations.

Question 25.—Have you had diabetic coma develop during or immediately after operation? *Answer.* Some 35 anesthetists have reported this complication with an incidence of 1 in 32,000 administrations.

Question 26.—What is your treatment for shock during an operation? *Answer.*

79 used saline	6 caffein
51 heat in some form	4 glucose
49 lower head	4 artificial respiration
31 adrenalin hypo	4 atropin
25 camphor-oil hypo	3 diagalen
16 pituitrin hypo	3 carbon dioxid
18 general stimulation	3 dilate rectal sphincter
13 morphin	2 coffee by rectum
14 oxygen	2 ergot
7 strychnia hypo	2 sodium bicarbonate

One anesthetist suggests binding the legs to conserve circulation and two report never having cases shock.

Question 27.—What is the status of the nurse anesthetist in your locality? *Answer.* This question aroused considerable reaction on the part of many who only answered other questions with a *yes* or *no.* It was reported that 3 anesthetist members of our Association had recently been ousted from hospital positions by nurses whom they had trained on account of economic exploitation. The situation is becoming more acute all over the country on account of the efforts of some to exploit all phases of the practice of medicine as well as the specialties by lay technicians on flat rate, or salaries. Nursing anesthesia is hardly in evidence in Canada. Forty-one report nursing anesthesia as increasing, due to their training by hospitals and anesthetists, 16 did not answer the question, 26 reported no nursing anesthesia, while 13 reported 1 or 2 nurses giving anes-

thetics in their cities, and the same number reported them in hospital service only, while 1 reported nursing anesthesia legalized in his state. It is important that more qualified medicine anethetists should be trained for the specialty especially on account of the fewer graduates from the medical schools as well as the shortage of internes.

Question 28.—Have you ever had a death from status lymphaticus autopsied? *Answer.* Only 8 report such autopsies making an incidence of 1 in 150,000 cases. This would seem to indicate that status lymphaticus is extremely rare and it should not be used to cloak sudden deaths on the table.

Question 29.—Have you ever had any anesthesia deaths? If so what anesthetic was used? *Answer.* 71 report no deaths. This would seem to be unusual. At the same time many have reported details of deaths under operation and anesthesia which could not honestly be considered as anesthesia deaths at all. At present the matter of what constitutes an anesthetic death is so undetermined as to make most reports debatable and uncertain. It is to be hoped that some definite record for anesthetic deaths will be drawn up for uniform reports, so that worth while statistics will become available.

Question 30.—What has been your experience with chloroform when adrenalin has been used? *Answer.* 11 deaths are reported, most of them in nose and throat operations in which adrenalin has been used as an astrigent and hemostatic. Levy and others have drawn attention to the danger of cardiac fibrillation in relation to the use of this combination and it should be avoided.

Question 31.—What do you consider the most potent factor in causing postoperative pneumonia? *Answer.*

63 exposure in some form
9 excessive mucus
8 aspiration
7 lack of resistance
7 unclean nose and mouth
7 irritation or respiratory tract
7 foreign bodies
5 associated pathology
3 each for sepsis, carelessness, too deep narcosis, long operations and emboli
2 never had a case.

Surgeons are becoming more and more convinced that the anesthetist and the anesthetic are not always the direct cause of postoperative pneumonia, as they encounter the complication as often with local as general anesthesia.

Question 32.—Have you had or heard of any explosions under anesthesia? *Answer.* 57 report explosions of one kind or another. Most of them due to alcohol heaters, electrical connections for heating or motor-blower purposes, or oil around oxygen valves and safeties. Several law suits have occurred and several are pending and it has been very unsatisfactory work in securing accurate data on account of the legal responsibilities of the hospitals, operators and anesthetists involved. Explosions have even occurred from personal static sparks and from static sparks in mercury manometers used in intratracheal anesthesia. A wet towel should always be on hand when using any heating device, cautery or flame, to smother the flames of any explosions that may occur. Many admit flirting with the danger of explosion by the use of improper agents or apparatus in the presence of danger. Such carelessness should not continue either on the part of operators or anesthetists and data should be collected and published about every possible way in which explosions may occur so that they may be avoided.

CONCLUSION.

Comparing the crude dangerous anesthesia of bygone years with the safe and pleasant anesthesias of today and there is but one verdict: a great advancement with untold benefit to suffering mankind. Let us all be more active in this great and good work.

1925 SEVENTH AVE.

A UNIVERSAL ANESTHESIA INHALER*

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From the title of this paper, you may get the idea that a mechanical contrivance of some sort, is to be shown. That is true, but I wish also to go further and comment on the several methods of administration and maintenance of anesthesia, which today are most universally used, both by the trained and the occasional anesthetist.

I have endeavored to place in the hands of both, a simple, efficient, accurate and well-balanced device, for the administration of all anesthetics, either by the open or by the closed method, using the sight drop feed for the volatile anesthetics and utilizing the body heat to prepare the vapor for inhalation by the patient. With this inhaler, anesthesia may be induced with nitrous oxid, with or without oxygen; with ethyl chlorid or with chloroform. In short then, here is an apparatus which, I think, will meet every desire of the anesthetist for the greater num-

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921.

ber of operations below the neck and a great many above.

DESCRIPTION OF THE INHALER.

The inhaler weighs one and three-quarters of a pound. It consists of an oil cup, with a sight drop feed, which holds two fluid ounces. A chimney piece with a sliding valve and a connection for a two and three-quarter liter bag. Below this a hollow ball with a hole in the bottom. The ball fits into a socket in the face piece and is held in any position up to an angle of 55°, by a friction ring and lock nut. This ball and socket joint permits the use of the apparatus in any operative position of the patient and to a great degree, enables the anesthetist to keep out of the field of operation.

The face piece is somewhat deeper than the average, because it has a cage fitted into the upper half. This cage contains the gauze ether pad. The ether is led, drop by drop, from the sight in the ether cup, through a tube passing through the chimney piece and the ball directly onto the gauze pad.

A slide valve, which is also an air vent, is fitted into the side of the chimney piece. This permits of an instant change from the open to the closed method of administration and a semi-closed position according to the needs of the patient or the wish of the anesthetist. Thus, with the valve wide open, no rebreathing can take place and with the valve closed, no air is admitted. Any position of the valve between these two extremes, regulates definitely the amount of air desired for the anesthetic concentration.

When used as a respiratory valve in the partly open position, the vent is expiratory, when the covering thumb is lifted during expiration and lowered on inspiration. It becomes an inspiratory valve by reversing the thumb action. The inhaler is kept at practically body temperature by the warmth of the anesthetist's hands, by direct contact with the patient's face and by the warm expired air of the patient.

PREPARING THE INHALER FOR USE.

After sterilization of all parts, especially the face and chimney pieces, fresh gauze is packed in the cage after each operation. The ball of course has been removed. A small gauze wipe, 1¾ by 2 inches and eight layers thick, is placed flat on the bottom of the cage. A second piece of gauze 4 by 7 inches and also eight layers thick, is then centered over the opening, with the long diameter of the gauze parallel to the long diameter of the mask. With one index finger the center of the gauze is pushed straight down to the gauze wipe and held there, while the other index finger pushes the protruding gauze off into the corners of the cage and onto the sides. It is impossible in this way to so pack the cage, that free passage of the respired air is interfered with.

The rubber cushion having been applied to the brim of the mask; the ether cup and the ball to their respective ends or the chimney piece and the bag in its proper place; the ball is set into the socket. The locking nut is backed down all the way. The friction ring on the ball is adjusted to a little more than the desired amount of tension and the locking nut then brought up to lock on the friction ring. The valve in the ether cup is closed. The cup may then be filled with ether and the inhaler is ready for use. The slide on top of the ether cup should be closed during the administration of an anesthetic to guard against spilling of ether.

METHODS OF INDUCTION.

Nitrous Oxid-Oxygen.—With the air vent in the chimney piece wide open, thus closing the valve to the bag, nitrous oxid is led into the end of the bag provided with a stopcock. Fill the bag with gas only, but, do not distend it. Place the mask over the patient's face and allow breathing for a few seconds through the open vent. This will help to quiet the nervous patient and relieve the fear of choking sensation. Talk to the patient and assure her that there will be plenty air in the bag. Then with the thumb covering the open vent, gradually close it. At the same time tell the patient that she is slowly getting the gas and to breathe normally. Do not allow a sudden rush of gas under pressure of a distended bag; that excites the patient and the induction will not be so smooth.

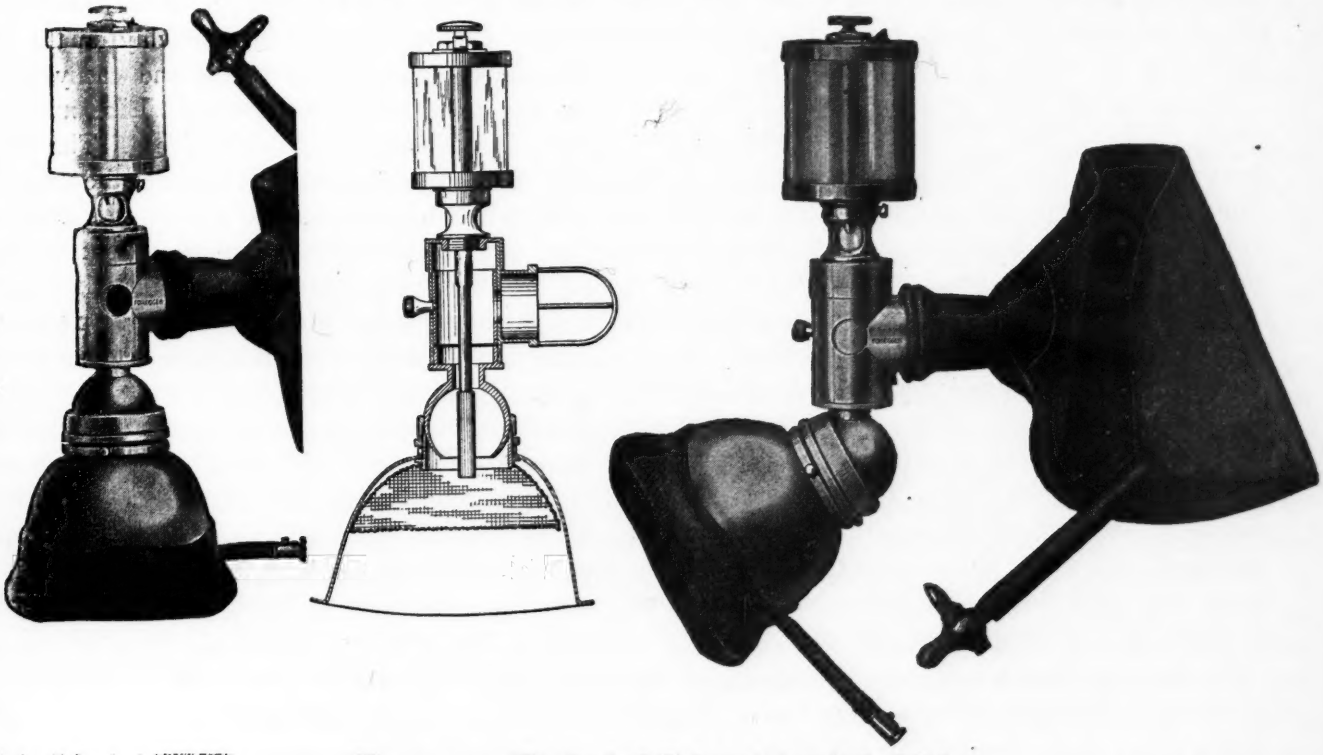
After a few seconds, open the vent about 1-32 of an inch, to allow the entrance of air, or, you may permit the oxygen to flow slowly from the source with the nitrous oxid. Keep the patient's color pink, though the slightest show of cyanosis will do no harm, it is not necessary. As soon as the patient fails to respond to the spoken voice, the ether drop is started, very slowly at first, say at the rate of about 30 to 40 per minute. This will insure an even distribution of the anesthetic and there will be no coughing, no salivation, no struggle and rarely an excitement stage.

Gradually the patient begins to breathe more quietly and deeply, and gradually you increase your ether drop rate until, after a minute and a half or two, since you began the induction, you will be dropping at the rate of about 125 drops per minute. Should the patient cough, reduce the drop rate consider-

ably and gradually work up again. When you have reached the stage of surgical anesthesia you will have used up from one and a half to two ounces of ether to the relaxation point. When a drop rate of 125 per minute has been maintained for several minutes, the gas-oxygen may be discontinued if so desired and the patient carried along at that rate for a period of about fifteen minutes when the drop rate may be lessened according to the depth of anesthesia that it is desired to maintain.

Induction with Ethyl Chlorid.—Close the stopcock in the bag. Close the vent in the chimney piece so that it will just admit the top of a Gebauer ethyl chlorid tube. Turn on the spray intermittently until the breathing becomes rapid and a slight stertor is audible. At this point the ether drop is started as with nitrous oxid induction. With ethyl chlorid, induction is very rapid and the ether must be started quite soon, usually within 45 seconds. Carry the patient along on the ethyl chlorid until he can, without coughing, take a drop rate of 125 per minute.

It may be necessary occasionally, to cover the vent with the thumb and syncopate as for an inspiratory valve. By so doing, the bag will quickly fill and rebreathing may be established. At this point the vent may be closed to 1-32 of an inch and the proper rate of ether flow maintained. It is not necessary to keep one eye on the time-piece and the other on the sight feed; one quite readily learns to gauge the proper rate of dropping and once this is mastered there will result a uniform technic, a beautifully smooth and delightful anesthesia, and in the great majority of cases, an uneventful recovery with little nausea and in many cases no vomiting.



Figs. 1, 2, 3, The Sanford Universal Anesthesia Inhaler.

ADVANTAGES.

The advantages, which acrue from the use of the inhaler, may be summed up briefly as follows:—The ether is properly volatilized by being administered drop by drop into a warmed chamber. The use of the rebreathing method with definite and positive admixture of air. The quantity of ether used is less than half the amount usually expended and is delivered on the mask drop by drop as needed, the reserve being held in the closed container; this preserves the gases in the ether to the last drop. You may instantly change from the open to closed or semi-closed method; from gas-oxygen-ether sequence to gas-ether, to oxygen-ether and to ether alone. You may, at any time, add the ethyl chlorid spray or stream. By disconnecting at the ball, you may continue the anesthesia with chloroform or with anesthol as an open mask administration.

Added to these administration features are those of construction, *namely,* simplicity, dependability, accuracy of ether flow, light weight, self-heating; no flutter valves but a positive slide valve and an adjustable feature in the ball and socket. The latter insures a balanced apparatus in the various positions of the patient.

OBSERVATIONS ON TWENTY CONSECUTIVE CASES.

Having at my disposal the means of comparing, side by side, by the mere turn of a valve, the virtues of the open versus the closed methods of administration, it was at once apparent that the open method was a far greater tax on the patient's vitality than was the closed. There was more mucus, excessive salivation, rapidity of the pulse and of the respiration and in many cases, early and marked perspiration. The amount of ether expended is, of course, much greater than with the closed method. There is of necessity also, chilling of the apparatus and of the respiratory tract, due to the more rapid volitization of the larger amount of ether.

Passing to the other extreme, that of the completely closed method, I found that within a very short period of time, it became necessary to admit some air, to relieve the cyanosis and to maintain a pink color. It was a revelation to me, however, to find that a remarkably small amount of air is necessary to maintain the proper pink color and how little ether is necessary for a satisfactory anesthesia.

The case records made and studied and figures for ether consumption, relate to Cotton Process Ether which was used in all of them, as I set out originally to try this ether. In all cases but one, anesthesia was induced with nitrous oxid and then continued with ether alone, so that the figures include, to a great degree, the induction period. One case was induced with ethyl chlorid.

The records show a remarkable steadiness of the pulse rate. The quality of the pulse was very good throughout. It is possible to gradually and definitely reduce the amount of ether as the operation progresses thus approaching the ideal of giving just enough ether. In many of the cases the drop rate at the end of the operation was one half or less than the rate during the first twenty minutes. Rarely did the drop rate exceed 125 drops per minute and then only for a very short period.

All the anesthesias were recorded in the *Impression of Anesthesia* as satisfactory or as very satisfactory, both from the standpoint of the surgeon and the anesthetist. The convalescence in all the cases was quite uneventful, vomiting and nausea being greatly reduced or absent altogether. All regained consciousness within one hour, some in a few minutes.

CONCLUSIONS.

1. It is possible and desirable to give ether by the drop method satisfactorily, thereby effecting an economy in the amount of ether expended and reducing the tax on the respiratory tract by chilling.

2. The rebreathing method is preferable, especially when it can be definitely controlled and utilized to prepare the ether vapor for inhalation without the use of mechanical heating devices.

HANDLING THE TOXIC GOITER UNDER ETHER-OIL COLONIC ANESTHESIA.*

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Toxic goiter is an incompetent term, for it fails to express the entire pathology of this serious disorder. The mind works more readily on the tangible and the gland being visible and easily studied has impressed the nomenclature. Like many diseases, its pathology is variously placed. The thyroid gland may secret a toxic substance, at the same time the adrenals are activated for greater energy and the liver stores and excretes superabundant glycogen, for the thyroid metabolizes, the adrenals energize, and the liver feeds. The effect is on the psyche; the brain is stimulated, particularly as to emotion. Reciprocally, the emotions of protection, fear, fright, and deep concern act on the susceptible thyroid to increase its activity, and the adrenals and liver respond in sympathy. This physiological complex is firmly set deep in the nature of man. It is a method of self-protection, automatic, and must be considered whenever we reason as to the thyroid, whether normal or abnormal.

METHODS OF HANDLING TOXIC GOITER IN DIFFERENT CLINICS.

No operation in surgery is beset with greater danger of grave complications than that of *toxic goiter,* the patient being more than ordinarily susceptible to passing emotion. The technic of thyroidectomy is simple and has been carefully worked out, a surgeon of average ability easily accomplishing it, yet, the leading surgeons and the most careful in their work are still striving for better results. No matter how well planned the operation, nor how well safeguarded the patient may seem to be, calamity occasionally comes and is dramatic.

The different schools in the United States have approached this problem from various angles. The Rochester school has developed a most perfectly worked out surgical technic, aided largely by that of Chicago. There are others who believe in local analgesia with novocain. This may seem ideal, but is not infrequently attended with pain and psychophysical results.

*Read during the Joint Meeting of the Canadian, Interstate and New York Anesthetists with the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921.

Crile exploits the psychic side, and emphasizes the great danger of mental disturbance, exciting the emotions of fear and despair. There are those who feel that the danger lies in the thyroid *per se*. Crile feels that the danger lies primarily in the mental attitude of the patient, and secondarily in the gland. After years of study and thought as a true metaphysician, he has elaborated anocithesia, which means to the mind what Listerism and asepsis means to technic. He treats the patient first, then the lesion. By personality and method of approach he desensitizes the mind, obtains confidence not only in himself but in his method by frequent small inocuous attentions, then substitutes nitrous oxid-oxygen for the subterfuge, fear having been eliminated.

But Crile and his surroundings are unique. Throughout the country there are hundred of institutions which must be called upon to care for *toxic goiters,* where they come but seldom and the surgeon is confronted with that which is to him unusual, of which he knows the grave dangers, and the responsibilities, both personal and familial, lie heavily. His local reputation is as much at stake as the condition of the patient, and with courage it is for him to do his best.

In the neighborhood in which we live toxic goiters are not common. We believe statisitics place this region at the bottom of the list. It seems strange that in a community of our size, with the strain of active American life, Wall Street, large enterprises, and much opposition in various occupations, more cases do not occur. Perhaps it is because our water supply is so excellent, but, be that as it may, we meet cases from time to time and have the chance to tryout the several methods which are much vaunted.

SELECTION OF THE ANESTHETIC.

Anything which affronts a person suffering from hyperthyro-adrenalism, which is *toxic goiter,* is an insult. Persons go to a hospital in trepidation. They leave their homes, occupation, and family. It is as a traumatism to the cerebral centers. They enter the hospital, which is gruesome in reputation, strange in sound, fearful as to outcome. The mind is necessarily greatly perturbed, ready for fright, or to enter into despair, because this syndrome is but chronic fright.

This rather extensive preamble on the *toxic goiter* seems necessary in order to demonstrate the immense importance of a careful selection of anesthetic and method of administration. To see a rag or cone placed over the face is to start a danger. To have a surgeon with anesthesia work on the neck and be conscious strains the best. So when Gwathmey elaborated ether-oil colonic anesthesia it seemed to us that at last there had been developed that method which would safguard the patient and make humane the treatment of this condition, and in the last few years we have operated upon the toxic goiter with this type of anesthesia.

ETHER-OIL COLONIC ANESTHESIA.

Under the new method, the patient enters the hospital, is placed in a quiet room, visitations reduced, carbohydrate diet instituted, water liberally given and a kindly nurse familiar with the method put in charge. The patient is given to understand that he is to receive a serum treatment most beneficial to him. Every day he is placed in the Sims position, the room darkened, and a hypodermic of water administered. In half an hour a catheter is introduced into the rectum and a few ounces of water thrown in, the catheter being allowed to remain in with the clip attached. After this has been done for several days, instead of water enema, 2 drams of paraldehyde and the same amount of ether are introduced. A half-hour later a hypodermic of morphin-atropin is administered, and in another half-hour 65 per cent ether and olive oil are allowed to run in at the rate of an ounce a minute until six, or not more than eight ounces are introduced, the catheter being allowed to remain in with a clip. In 3 minutes there is the odor of ether on the patient's breath and he demonstrates all the signs of somnolence, dropping gradually and smoothly into the most delightful slumber, during all this time not the least conscious of any variation from the usual routine.

So far, our results have been most excellent. Never have we, in all our surgical work, been so delighted with an effect produced. Slowly and quietly the patient goes into a slumber, then into a quiet sleep without stertor. It is a most beautiful picture of calmness, and the operation can be done slowly and comfortably, as there seems no need for haste. This operation should be completed by any one who has the right to operate in about half an hour, so the anesthesia will hold well for that time.

QUESTIONS FOR SOLUTION.

We had thought that at last the ground was safe, that with a safe anesthesia and a comfortable conducted operation our worries were to cease, but on searching into the literature we find, from time to time, there have been depressing complications and deaths. We find that but few men have taken up the method; some enthusiastically claim in the short time since Gwathmey introduced it they have reached their four figures. But the general profession has not as yet taken kindly to it. Our big clinics, to which

we look for guidance and where problems are studied most thoroughly and carefully, and whose teachings can be relied upon, do not seem to be employing this method, and we are worrying now about out next case. Will it suffer from the bloody flux; will it be complicated by calamity or possibly death, the result of the anesthesia? Will we have a repetition of our experiences when we used spinal cocainization—the threat of lawsuit? If we should have a mishap, are there not those who will call us on the stand to defend ourselves, and produce witnesses to testify that this method has not been well established and that it is not the method customary in the best clinics? Will we have a proper defense?

The Associations of Anesthetists are proups of specialists who have taken over to themselves a certain department. Do they not owe it to the surgical profession that they thoroughly, completely, and carefully work out methods of anesthesia, so that they will not be a matter of personal opinion nor an expression of confidence of a few surgeons, but that every practitioner in the land can have confidence in his anesthesias, the same as in the surgical technics established by the Mayos, Murphy and Crile?

We are much interested in ether-oil colonic anesthesia. It seems an admirable and clever way of *stealing the thyroid,* but as yet it has not been proven a safe procedure. Abundant statistics from many clinics are necessary to safeguard the patient as well as the medico-legal responsibilities of the surgeon. We would welcome reports from the anesthetists as to morbidity, complications and mortality, along the same lines as those made by surgeons in their work, and annual statements compiled and published by these Associations would be an honest confession of popularity of procedure and practical value.

1922—MEETINGS—1922.

1. Pacific Coast Association of Anesthetists and Section on Anesthesiology, Yosemite, California, May 15-16.

2. American and Mid-Western Associations of Anesthetists and A. M. A. Anesthesia Session, Hotel Jefferson, St. Louis, May 22-24.

3. Canadian Society of Anesthetists and Canadian Medical Association, Royal Alexandra Hotel, Winnipeg, June 20-23.

4. Interstate Anesthetists and National Anesthesia Research Society, Hotel Deshler, Columbus, O., October 30-November 1.

5. Southern Association of Anesthetists (Organization Meeting) and Southern Medical Association, Chattanooga, Tenn., November 13-16.

A STUDY OF THE ANURIAS OCCURRING IN NORMAL ANIMALS DURING A PERIOD OF ANESTHESIA BY ETHER AND CHLOROFORM.*

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As a result of investigations[1] [2] made some years ago it was found that chlorofrom was far more toxic for the kidney than was ether. The further observation was made, that when the kidney was severely injured by these substances the usual diuretic solutions were of no value in reestablishing a flow of urine. In several recent publications the results of investigations have been reported concerning the effect of the general anesthetics for the acutely nephropathic kidney[3] [4] and also for the kidney the seat of some type of chronic nephropathic process[5] [6]. In later papers[7] [8] studies have been undertaken, which were concerned with the development of the anurias in normal animals following the use of the general anesthetics and an attempt has been made to explain the toxic effect of these substances for the kidneys of certain normal animals and their relative lack of toxic action for the kidneys of other animals.

From both a laboratory and a clinical point of view this question is of interest and importance. In experimental work on the higher animals the observation is rather frequently made that following a period of normal anesthesia in a normal animal, the animal becomes anuric and persists in this state to the termination of the experiment. Less frequently following an anesthesia in man the same type of reaction is obtained. The individual following a period of anesthesia forms only a small amount of urine which contains albumin and casts and frequently glucose. In other instances the individual become anuric for some hours or days or this condition persists until death. From these observations this type of experimental inquiry into the cause of the anesthetic anurias would appear to be worth while.

EXPERIMENTAL METHOD.

The present investigation is based on the study of 98 normal dogs which were anesthetized by either chloroform or ether. Thirty-two of these animals received chloroform and the remaining sixty-six animals were given ether to the point of a safe surgical anesthesia. The duration of the anesthesia was not over two hours and forty-five minutes. During the course of the anesthesia thirty-one of the animals

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921. From the Laboratory of Pharmacology of the University of North Carolina.

became temporarily or permanently anuric. All of the animals during the experiments were given one or more diuretic solutions.

The technic of the experiments has been essentially simple. Dogs were used in all of the experiments. The animals were placed in metabolism cages and studied for two to four days prior to any experimental procedure. The urine was examined qualitatively for albumin, glucose, acetone and diacetic acid. Centrifugalized specimens of urine were examined for casts. The functional capacity of the kidney was determined by the phenolsulphonephthalein test of Rowntree and Geraghty[9]. The acid base equilibrium of the blood was determined by the indicator method of Marriott[10]. The animals included in this study were normal insofar as renal function was concerned. Three of the dogs showed a trace of albumin in the urine with Mayer's reagent, but not with other reagents. The appearance of the albumin was transitory. Casts were not present in the urine from any of the animals. The urine from five of the dogs gave a positive test for glucose with Benedict's reagent. Acetone and diacetic acid were not present. The elimination of phenolsulphonephthalein in a two hour period in the various animals varied from a minimum output of 68 per cent to a maximum output of 80 per cent. The reserve alkali of the blood was normal and showed a variation from 8.05 to 8.15.

After ascertaining that the animals were normal the following technic was used for the experiments. At the commencement of the experiments, the anesthetics, chloroform or ether were given from an ordinary cone with a free mixture of air. As soon as the animals were partially anesthetized a tracheal canula was tied in and connected by means of a short rubber tube of large bore to a Cushny anesthesia valve, the latter being attached to a glass jar containing the anesthetic. By such an arrangement the mixture of air and anesthetic vapor can be regulated with fair constancy during the course of the anesthesia. During the experiments the animals were kept in an operating frame surrounded on three sides by a copper box which contained hot water. This devise was first used in Sollmann's laboratory and is employed to maintain the animal's body temperature and prevent the development of shock. Glass canulas were placed in the carotid artery and the femoral vein. The carotid canula was connected to a mercury manometer while the femoral vein canula was connected to a burette from which the diuretic solutions were introduced into the animal. The ureters were exposed by a midline abdominal incision and catheters tied in. The kidneys were not disturbed. At the termination of all experiments the kidneys were removed prior to the death of the animals and studied histologically.

The Effect of Ether Anesthesia on Urine Formation in Normal Dogs.

Sixty-one normal animals were anesthetized by ether. With the completion of a satisfactory state of surgical anesthesia in these animals the carotid blood pressure has been well maintained. In two very old animals at this period of the etherization the blood pressure had fallen to 58 and 64 mm. of mercury for the respective animals. The breathing was very shallow and slow and within a few minutes the heart ceased to beat. In the other animals the carotid pressure varied from 112 to 142 mm. of mercury. All of these animals remained diuretic during the early stages of the experiments. The average flow of urine has been 4 drops per minute. Only one animal that was given ether became anuric within the first half-hour of the experiment. In this animal the blood pressure at the commencement of the experiment was 132 mm. of mercury, the reserve alkali of the blood was 8.1 and there was a flow of urine of 8 drops per minute. By the end of the first half-hour of the experiment the carotid blood pressure had fallen to 78 mm. of mercury. The reserve alkali of the blood remained unchanged. *With this disturbance in the circulation the animal became anuric. The animal was given* 10 *cc. per kilogram of a* 5 *per cent solution of glucose. The carotid pressure rose to* 125 *mm. of mercury and with this improvement in the circulation the animal became freely diuretic forming* 21 *drops of urine per minute.* The anurias which develop in normal dogs anesthetized by ether at a later period of the experiments may or may not show this type of response.

In the animal of Experiment 16 the same kind of circulatory disturbance developed at the end of a two hour period of etherization. At the end of the first hour of the experiment the animal showed no change in the alkali reserve of the blood. The carotid blood pressure had fallen in this period from 142 mm. of mercury to 118 mm. of mercury. The animal was forming six drops of urine per minute. By the end of the second hour of the experiment the animal was anuric. During the second hour period only a slight depletion had taken place in the reserve alkali of the blood. The reserve alkali had been depleted by the anesthetic from the normal of 8.15 to 8.05. The carotid pressure had fallen to 81 mm. of mercury. The animal was anuric. The animal was given intravenously 20 cc. per kilogram of a 0.9

per cent sodium chlorid solution. The carotid pressure rose to 126 mm. of mercury. Associated with this change in blood pressure and the hydremic state of the blood, urine formation recommenced. The animal formed 9 drops of urine per minute.

The animal of Experiment 4 anesthetized by ether shows an entirely different type of reaction which may also be associated with the development of an anuria. The animal became anuric during the second hour of the experiment. At the commencement of the experiment the animal was forming 7 drops of urine per minute. The carotid pressure was 130 mm. of mercury. The reserve alkali of the blood was 8.1. By the end of the first hour of the etherization the reserve alkali was depleted to 8.0. The carotid pressure had increased to 132 mm. of mercury. The animal was forming four drops of urine per minute. One hour later the reserve alkali of the blood showed a depletion to the low reading of 7.85. The carotid blood pressure had increased to 134 mm. of mercury. The animal was anuric. At this time the animal was given intravenously 1 cc. per kilogram of a 1.0 per cent solution of theobromin. The carotid pressure rose slightly to 138 mm. of mercury. The reserve alkali of the blood continued to be depleted and gave a reading of 7.8. The animal formed no urine. Half an hour later the animal received 20 cc. per kilogram of 0.9 per cent sodium chlorid. The reserve alkali of the blood remained unchanged. The carotid blood pressure rose to 142 mm. of mercury. The animal remained anuric.

This experiment is illustrative of a second type of anuric state which may occur late in an etherization and which is not dependent upon a fall in systemic blood pressure, but which is associated with a disturbance in the alkali reserve of the blood. In such an anuria the various diuretic solutions are of no value.

THE EFFECT OF CHLOROFORM ON URINE FORMATION IN NORMAL DOGS.

Thirty-two normal dogs have been anesthetized with chloroform. The chloroform was administered with a technic identical to that employed for ether. The duration of the experiments has been the same with both anesthetics.

A study of the experiments conducted with chloroform shows that in general at the completion of a state of surgical anesthesia the carotid blood pressure is lower in these animals than in the group of animals anesthetized with ether. The blood pressure in the different animals has varied from 98 to 114 mm. of mercury. The urine flow at the commencement of the experiments in the animals anesthetized by chlorofrom has not been over 3 drops per minute.

A study of the anurias which develop in these animals show that unlike the early anurias that occurred in the etherized animals, the anurias in the animals receiving chloroform are not constantly associated with a state of low systemic blood pressure.

This observation is clearly illustrated in animal Experiment 14. With the development of a satisfactory state of surgical anesthesia the animal had a carotid blood pressure of 112 mm. of mercury. The reserve alkali of the blood was reduced from the reading of 8.15 prior to the anesthetic to 7.9. The animal was anuric. The animal received intravenously 20 cc. per kilogram of 0.9 per cent sodium chlorid solution. The carotid pressure rose to 121 mm. of mercury. The reserve alkali of the blood continued to fall to 7.85. The animal remained anuric.

Early in the experiments in the animals anesthetized by chloroform there is a greater tendency to a depletion in the alkali reserve of the blood than occurs in animals anesthetized by ether. In such animals the anuria is not relieved by the use of diruetic solutions which stimulate renal epithelium or which act by increasing the water content of the blood and by raising systemic blood pressure.

A study of the changes induced in the animals anesthetized by chloroform shows that as the anesthesia progresses there is a gradual or sudden depletion in the reserve alkali of the blood. There is furthermore a greater reduction in the systemic blood pressure of the animals. In such animals with a falling systemic blood pressure and also with a reduction in the alkali reserve of the blood the diuretic solutions are less effective than they are in animals anesthetized with ether, in which there may be a marked reduction in blood pressure, but the reserve alkali of the blood is more nearly maintained at the normal.

The animals anesthetized by chlorofrom that have become anuric by the end of the first hour period of the experiment have shown a marked depletion in the alkali reserve of the blood. The animal of Experiment 6, at the completion of a state of surgical anesthesia[3] had a carotid blood pressure of 98 mm. of mercury. The reserve alkali of the blood was 8.0. There was a flow of urine of 2 drops per minute. By the end of the first hour of the experiment the blood pressure had increased to 112 mm. of mercury. The reserve alkali of the blood had been depleted to 7.9. The animal was anuric. The animal received 1 cc. per kilogram of a 1.0 per cent solu-

tion of theobromin. The systemic blood pressure rose to 118 mm. of mercury. The reserve alkali remained unchanged. The animal was nonresponsive to the diuretic solution.

The same type of reaction is shown by the animal of Experiment 20. At the commencement of the experiment the animal had a systemic blood pressure of 112 mm. of mercury. The reserve alkali of the blood was 8.1. The animal had a flow of urine of 4 drops per minute. At the end of the first hour of the experiment the blood pressure had fallen to 92 mm. of mercury. The reserve alkali of the blood was reduced to 7.95. The flow of urine was reduced to 2 drops per minute. At the end of the second hour of the experiment the blood pressure had undergone a further reduction to 81 mm. of mercury and the reserve alkali of the blood was reduced to 7.8. The animal was anuric. Following the intravenous injection of 10 cc. per kilogram of a 5 per cent solution of glucose the carotid blood pressure rose to 122 mm. of mercury. The reserve alkali of the blood at this time gave a further depletion to 7.7. No urine was formed.

This experiment illustrates the lack of effect of a diuretic solution in influencing a flow of urine in an animal with a low systemic blood pressure and with a marked disturbance in the acid-base equilibrium of the blood. The solution may induce a rise in blood pressure which is adequate for urine formation, but it has no ability to change the pathology of the kidney responsible for the anuria and which is associated with the development of an acid intoxication.

PATHOLOGY OF THE KIDNEY IN ANURIC NORMAL ANIMALS.

The anurias which have developed in these animals have either been associated with a low carotid blood pressure and no disturbance in the acid-base equilibrium of the blood or they have occurred in animals in which with or without a marked reduction in carotid blood pressure there did exist a definite disturbance in the acid base equilibrium of the blood as shown by a reduction in the alkali reserve. The anurias which have occurred in animals anesthetized by ether very largely fall in the first group. In such animals the kidneys appear pale and on sections show no congestion. Histologically the kidney tissue has appeared normal. The glomerular capillaries contain but little blood and incompletely fill the subcapsular space. The tubular epithelium appears normal. Stainable lipoid material is found in the loops of Henle.

Those animals anesthetized by ether or chloroform that have become anuric with an associated disturbance in the acid-base equilibrium of the blood show a very different type of renal injury. The kidneys in general are pale. In those animals that have become anuric with a well maintained blood pressure the glomerular vessels fill the subcapsular space and the capillaries appear engoged with blood.

In the animals that become anuric with a low carotid pressure the vascular changes are similar to those described in the anuric animals in which there was no reduction in the alkali reserve of the blood. The essential difference in the pathology of the kidney in animals anuric with a reduction in the alkali reserve of the blood and in those animals in which the alkali reserve has not been disturbed is found in the tubular epithelium. If the anuria is associated with a disturbance of the acid-base equilibrium of the blood, the epithelium especially of the convoluted tubules, if found to be edematous, vacuolated, and becoming necrotic. The cells of the loops of Henle contain much stainable lipoid and similar material is found in the injured convoluted tubule epithelium. It is in this type of anuric animals that diuretic solutions are of no value.

CONCLUSIONS.

The investigation has shown that normal dogs with a urine free from albumin and casts and with a normal elimination of phenolsulphonephthalein, may, following an anesthetic become acutely anuric. The anurias have been associated with either a low carotid blood pressure, a marked disturbance in the acid-base equilibrium of the blood, or both conditions may exist in the same animal. If the anuria is due to the low systemic blood pressure, it can be relieved by various diuretic solutions. If, on the other hand, it is associated with a marked disturbance in the acid-base equilibrium of the blood such diuretic solutions are of no value in inducing a flow of urine. The above observations would indicate that in the preparation of a patient for a general anesthetic, the diet should be of such quantity and quality as to prevent the development of an acid intoxication. The occurrence of such a condition can furthermore be guarded against by the judicious use of sodium bicarbonate.

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SURGICAL ANESTHESIA IN RELATION TO DIABETES MELLITUS*

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A successful surgical operation on a diabetic patient depends largely on three factors, the preoperative preparation of the patient, the skill of the surgeon, and the method of anesthesia. Four types of anesthesia can be safely used, intraspinal or paravertebral, nitrous oxid or nitrous oxid and oxygen, local with cocain or novocain, and ether. In discussing any anesthetic in relation to diabetes, however, it should be remembered that all patients with this disease are abnormally poor surgical risks for two reasons, *first*, the danger of postoperative infection, and *second* the danger of postoperative acidosis. Foster has laid down a general rule in regard to the surgical treatment of diabetes which is worth emphasizing. *Patients with hyperglycemia of more than* 0.35 *per cent, or a carbon dioxid combining power of the blood plasma of less than* 40 *volumes per cent cannot be expected to survive any operative procedure. Patients with hyperglycemia above this amount and without acidosis often die of postoperative infection. Patients without hyperglycemia but with more than this amount of acidosis are inclined to pass into coma.*

METHODS OF ANESTHESIA.

Intraspinal or *paravertebral anesthesia* has been used in but few reported cases of diabetes. Joslin has found it satisfactory in several instances, although he believes that it is often undesirable because of the nervous tension to which it subjects the patient. I have observed one patient with a mild diabetes, who was operated on for hernia under intraspinal anesthesia who subsequently developed an acidosis severe enough to threaten life. On this account, chiefly, I am prejudiced against this type of anesthesia, the more so because no careful data have been recorded with regard to the pharmacologic effect of such a method of anesthesia in a large series of diabetic cases.

Nitrous oxid or nitrous oxid and oxygen are frequently employed for anesthesia in diabetes, especially for minor operations. Both of these anesthetics seem harmless. Nausea or vomiting rarely follows, which is an important point in their favor, as the prognosis for a nauseated diabetic patient is far worse than for one with a sound stomach capable of absorbing fluids. There is one serious objection to these anesthetics for major operations, namely, difficulty in administration. One often sees an operation begun under gas-oxygen anesthesia and finished under ether. It may be possible in this fashion to minimize the amount of ether given, which is important. On the other hand, it is sometimes difficult to adjust the ether-oxygen mixture so perfectly that the patient does not become cyanosed, or restless. These complications should be carefully avoided on account of the production of increased hyperglycemia.

I have studied the effect of gas-oxygen anesthesia on the blood chemistry of several diabetic patients and have been impressed with the reaction which it apparently produces. It causes hyperglycemia without acidosis, and even seems to reduce a moderate acetonemia. On this account, theoretically, it is an excellent anesthesia for diabetics. This opinion is supported by Joslin's practical experience. He considers nitrous oxid or gas-oxygen the best general anesthetics for diabetics provided they are administered by one trained in their use.

Local anesthesia with cocain or novocain, or *general anesthesia with ether*, will probably continue to be the two anesthetics most widely used. Patients with diabetes complicated by infection and marked acidosis, who appear to be poor surgical risks on this account, often survive minor operations under local anesthesia and improve surprisingly when the infection is properly treated.

Local anesthesia, too, is the anesthetic of choice in operations such as tonsillectomy or the removal of

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921. From the Section of Internal Medicine, Mayo Clinic, Rochester, Minn.

teeth. On the other hand, it may have a serious disadvantage for major operations. If a wide area of skin is infiltrated to procure anesthesia, the area along the line of incision may become infected and be followed by chronic suppuration resulting in lowered carbohydrate tolerance. On the whole, local anesthesia is satisfactory in most cases, as it is not often followed by acidosis or infection.

ETHER ANESTHESIA IN RELATION TO OPERATIONS ON DIABETIC PATIENTS IN THE MAYO CLINIC.

Ether is the most popular anesthetic from a surgeon's point of view. It has certain theoretic objections in cases of diabetes as it is known to cause acidosis and hyperglycemia in the normal person and this reaction may be exaggerated in patients with diabetes. Because of this, most internists advise against its use, preferring gas-oxygen or novocain. Berkman, of the Mayo clinic, is the chief advocate for the general use of ether in operating on diabetic patients, believing that it is the anesthetic of choice when given under proper conditions. If ether is employed both anesthetist and surgeon must remember Crile's statement; *the surgeon and anesthetist alike must realize that during an operation each is draining the store of reserve alkalinity. The surgeon must use gentle manipulation and produce the least possible trauma in order to conserve the patient. The anesthetist must use the lightest possible even anesthesia administered with the least psychic trauma.*

Experience with ether in cases of diabetes in the Mayo Clinic during the last year bears out Berkman's earlier views. The amount of ether given to each patient, however, was small and the duration of anesthesia was short. In order to demonstrate this fact graphically, one hundred records of patients who received ether anesthetic for abdominal operations were analysed as follows:

The weight of each patient, the volume of ether administered, and the duration of anesthesia from the moment the drug was first inhaled until it was stopped were recorded. These results were averaged and tabulated. Similar data from the surgical records of a representative general hospital were obtained and averaged for comparison. In each series the operations were performed on chronic non-diabetic patients without evidence of acute infection, and, in order to rule out any question of personal selection, were selected indiscrimiately from the mass of material at hand. The results of this study are tabulated.

TABLE I.

Abdominal Operations One Hundred.

	Mayo Clinic Group 100 Abdominal Operations	Control Group 100 Abdominal Operations
Average weight of patients	64.5 kg	61.3 kg
Average volume of ether for each patient	170 cc.	267 cc.
Average duration of anesthesia for each patient	48 min.	102 min.

As may be seen, the patients in the Mayo Clinic series were given much less ether, on the average, and the anesthetic was inhaled for a much shorter time than did the control patients. This is of the utmost importance in operations on diabetic patients and is probably one of the factors accountable for the low mortality reported by Berkman, especially since the diabetic patients in the Mayo Clinic are etherized with special circumspection and would presumably show even lower percentages than those recorded.

In order to minimize the amount of ether given, a combination of local and ether anesthesia can be satisfactorily used. For example, Dr. W. J. Mayo recently performed a hysterectomy on a diabetic patient under such combined anesthesia. The patient had developed marked acidosis during preliminary treatment. She inhaled only 120 c. c. of ether, had a perfect anesthesia, and subsequently made an uneventful recovery.

A certain percentage of diabetics will do badly, necessarily, despite the most careful preoperative care, the best surgery, and the most skillfully administered anesthetic. These patients are not always those with the severest type of the disease nor those who are given any particular type of anesthetic. In operating, therefore, the surgeon and the anesthetist must comprehend the severity of the condition and be on guard for unusual manifestations.

CONCLUSIONS.

On the whole certain general rules with regard to the anesthesia of diabetic patients can be formulated.

1. All diabetic patients are abnormally poor surgical risks, and must be recognized as such by the internists, surgeons and anesthetists.

2. The preoperative and postoperative care of the patient, the type of anesthetic used and the skill with which it is given are of as much importance in prognosis as is the technique of the operation.

3. The patient who has a blood sugar concentration of more than 0.35 per cent or a carbon dioxid combining power of the plasma of less than 40 volumes per cent is an extremely hazardous surgical risk for any operation under any anesthesia.

4. Spinal anesthesia may be dangerous for routine use in diabetes and unless there is some direct indication for its employment should not be used.

5. Nitrous oxid or nitrous oxid and oxygen are safe inhalation anesthetics provided the technic of

their administration is perfect. Cyanosis or struggling should be avoided.

6. Local anesthesia with cocain or novocain is the saftest anesthesia for general use in diabetic patients.

7. Ether anesthesia is well borne in many cases. It should not be given in septic cases, however, and must never be given unless the operation can be performed rapidly and unless a small amount of the drug can be employed. If it has to be used in a doubtful case it can be satisfactorily combined with local anesthesia so that the amount of anesthetic inhaled is minimized.

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PAROXYSMAL TACHYCARDIA AS AN OCCASIONAL UPSET DURING ETHER ADMINISTRATION.*

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GENERAL CONSIDERATIONS.

Our knowledge of the abnormalities of the mechanism of the human heart during anesthesia is still quite meager. If upsets take place they are apt to be overlooked or to receive only superficial attention; in either case we are left in the dark as to the cause or the type of the disturbance. In our ignorance, such upsets may be called *shock* by one observer and *acute dilation* of the heart by another. No doubt many cases fall into the group that goes under the name of shock, and in others they may be an acute dilation of the heart. This discussion does not concern itself with the former, but some observations were made that throw light on the latter. Any information that will enable us to describe accurately the disturbance that occurs may prove of value in the treatment of the patient. As we shall see, this was the case in patients to be reported here. Moreover such information will help us remove from vague medical wastebaskets certain clinical entities that are well understood.

For the past several years I have been interested in a group of surgical patients that either during the anesthetization or the surgical convalescence have had sudden queer disturbances of the heart. I wish to report the events in three such patients that interest you because the disturbance took place during the administration of the anesthetic. For a discussion of the upsets that occurred in a group of cases following operation you are referred to a recent publication by the author[1].

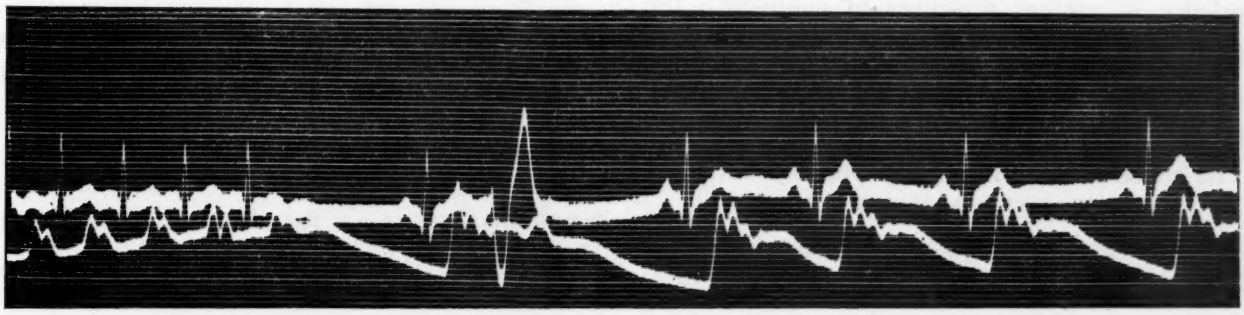
ILLUSTRATIVE CASE REPORTS.

CASE 1 (S. 2140). A student, 17 years old, with a completely negative past history, entered the hospital for a fractured clavicle. He received 0.01 gm. morphin and 0.0005 gm. atropin hypodermically as a pre-operative measure. The patient was etherized at 10.15 A. M., and the heart rate, which had been regular and 100 to the minute, suddenly jumped to about 150 at 11 A. M. The general condition of the patient seemed to be satisfactory and, therefore, despite the rapid heart rate, the operation, which was wiring of the clavicle, was completed. *The tachycardia persisted and several hours later electrocardiograms were taken which showed that the acceleration was not a normal one, but rather of the type of paroxysmal auricular tachycardia. As this condition can frequently be arrested by vagal stimulation it was attempted on this case. While the patient was still drowsy from the ether, pressure was applied over the right carotid artery and the heart rate suddenly fell from over* 150 *to about* 70. The transition from the abnormal rapid rate to the slow one is shown in Figure 1. The patient had a normal surgical convalescence and was discharged in good health, although he continued to have frequent attacks of tachycardia which he was taught to control himself.

CASE 2 (S. 2028). An engineer, 46 years old, entered the hospital with enlarged glands in the neck. He had a history of gonorrhea and some sort of chancer at the age of 16. The Wassermann reaction was negative and there were no signs of syphilis. There had been some slight dyspnea on exertion for one year, but never any palpitation. Many years before he had been operated on for similar glandular enlargement, which was found to be cancer. On physical examination the heart was slightly enlarged, but otherwise unusual, the blood pressure was normal and the urine was negative except for an occasional cast. The patient was given 0.015 gm. morphin and 0.0005 gm. atropin hypodermically and then was etherized. Nothing unusual happened during a rather extensive disection of the neck. After the operation was over, but while the patient was still

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921. From the Medical Clinic of the Peter Bent Brigham Hospital.

unconscious from the anesthetic, the heart rate suddenly jumped from 70 to 170. The condition of the patient did not seem to be alarming and so we felt justified in taking the time to prove the clinical diagnosis of paroxysmal tachycardia by taking electrocardiograms, before anything was done to end the attack. This was done and the clinical diagnosis found to be correct. *Repeated attempts to end the attack by pressure on the left and right vagus nerves were unsuccessful. Several years ago*[2] *I found that pressure over the eye balls had an even greater inhibitory effect on the heart and thereby produced greater slowings of the rate than direct pressure over the vagi. This procedure is somewhat painful, but inasmuch as the patient was unconscious and the attack could not be stopped in any other way, it was thought advisable to try it. Fortunately left ocular pressure was successful in ending the attack, the heart rate suddenly dropping from* 195 *to* 88. The patient subsequently made a very successful recovery and was discharged from the hospital in good health. He never had any further attacks of tachycardia. He returned three years later and died of recurrent carcinoma of the pharnyx.



Vx

Fig. 1. (Case 1.) Upper tracing is the electrocardiogram, lower is the brachiogram. The first 5 regular and rapid beats show the end of the anode of *auricular tachycardia.* The transition was produced by right vagal pressure. The normal rhythm is restored after a long pause. The highest peak marks an extra-ventricular beat.

CASE 3 (S. 11598). A woman of 46, entered the hospital for gallstone colic. There was a past history of rheumatic fever at the age of 8 and she had chorea for two years in childhood. During the two years before admission she noticed dyspnea on exertion and occasionally palpitation. No definite history of attacks of tachycardia could be obtained. The diagnosis of gall stones was made on a history of typical attacks of colic in the abdomen. Examination of the heart showed definite signs of well compensated mitral stenosis. The patient was given 0.01 gm. morphin and 0.0005 gm. atrophin subcutaneously and then was etherized. While the abdomen was being prepared, but before the actual operation was started, breathing suddenly stopped, she became markedly cyanotic and the heart rate was found to be 216 and regular. Artificial respiration was started, and after several minutes, attempts were made to stop the tachycardia by vagal pressure. There was no opportunity to confirm the diagnosis by electrocardiograms, but the perfectly regular apex rate of 216 and the ultimate result rule out other diagnosis than paroxysmal articular tachycardia. *After several attempts at both right and left vagal pressure had been made, pressure on the left carotid artery suddenly restored the heart to the normal rhythm. The rate fell from* 216 *to* 112 *in one beat.* The patient was subsequently operated on with gas-oxygen as the anesthetic and a gall-bladder containing stones was removed. She had no subsequent attcaks of tachycardia and left the hospital in excellent condition.

DISCUSSION.

The above three cases illustrate the same abnormal mechanism. In each instance the patient, while under ether, suddenly developed a rapid regular heart rate. In two, the clinical condition of the patient did not become serious as a result of the upset, while in the third it became rather alarming. In all, the attacks were ended by some form of vagal stimulation; in two by pressure over the carotid arteries, and in the other by ocular pressure. This condition is called paroxysmal auricular tachycardia and results when some abnormal focus in the auricular wall takes on the function of pacemaker of the heart and subdues the normal pacemaker in the sino-auricular node. The resulting rate is always regular and generally between 150 and 250. The attacks always start and end suddenly without any warning. They may last minutes, hours or even weeks. Although usually if undisturbed the patient suffers little except the temporary discomfort, occasionally very serious results occur. Two such operative cases that ended fatally occurred in New York.

It is impossible from this limited study to learn the precipitating causes of the attacks. What rela-

tion they may have to the anesthetic and to the preoperative medication, *i. e.*, morphin and atrophin, remains uncertain. It is important for surgeons and those interested in anesthesia to bear this condition in mind, particularly as it so frequently responds to proper treatment. The sudden development of a rapid heart rate should make you think of paroxysmal auricular tachycardia. The heart does not gradually climb up to 150 or 200, but in an instant may change from a normal rate to an extremely rapid one. The end of the attack is just as sudden. It may be difficult for those who have not an intimate knowledge of cardiac disorders to distinguish the type of tachycardia that these three patients developed, from some others (auricular fibrillation and auricular flutter) that I have observed during surgical convalescence. These latter will possibly be found to occur in the course of time during anesthesia as well. It will be important to distinguish the various types because vagal stimulation will have no effect on the latter, while digitalis properly administered acts very beneficially. For a discussion of the clinical differentiation of the various forms of rapid heart action, the reader is referred to a recent publication by the author[3].

CONCLUSION.

Sudden and very marked increase in the heart rate was observed in three patients during ether administration. This condition was found to be paroxysmal auricular tachycardia, a disturbance more commonly met with in medical patients. In each instance vagal stimulation proved successful in ending the attacks. It is urged that anesthetists should keep the possibility in mind during ether administration in order that proper treatment may be instituted as soon as possible.

21 BAY STATE ROAD.

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POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG.*

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I venture to bring to your notice a postoperative complication which perhaps, for want of a better term is known as postoperative massive collapse of the lung. From a relatively small experience I feel sure that it is a more common occurrence than is generally recognized, and that many cases previously and still called postoperative or anesthetic pneumonia, really fall into this category.

GENERAL CONSIDERATIONS.

Seven of the cases have been previously reported in a paper read before the Congress of the American College of Surgeons, in October, 1920. Since then four others have been added to the series. Of the eleven cases observed 7 occurred in the Prince of Wales Hospital in a series of 540 consecutive operations, and 4 in the Royal Victoria Hospital, Montreal.

With one exception (the removal of hemorrhoids) all cases followed operations on the abdomen.

The anesthetic used in the series of 540 operations, in which 7 cases of this complication occurred, was chloroform induction followed by open ether; in 3 nitrous oxid-oxygen followed by ether, and in one nitrous oxid-oxygen and local anesthesia with 0.05 per cent procain. All the patients were young adults in good physical condition. There was no mortality, though nearly all were seriously distressed for 2 or 3 days. The duration of the operations cannot be given accurately, but varied approximately from 20 to 45 minutes.

COINCIDENTAL FACTORS.

In 5 cases some condition was noted either before, during or after operation which may have had some bearing on the development of the condition. None of these may have had any causal relation to the development of the collapse and yet they have a cumulative importanace which cannot be set aside without due consideration.

In one case, a strangulated hernia of 6 hours' duration, the patient had suffered a great deal of pain and entered the hospital *thoroughly chilled from a long drive on a bitterly cold winter night.* Operation was delayed one hour until it was thought that the patient had been sufficiently warmed.

One man, operated on for a subacute appendicitis,

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was unusually nervous before the anesthetic and it was noted that the pulse rate was 120 throughout the operation from no apparent cause.

One man, subsequent to his recovery from the collapse, developed a tonsilitis and with that an edema of the larynx, which suddenly appeared and suddenly disappeared, as does the angioneurotic type.

One other, a Pole, speaking no English, fought hard and long during the induction of the anesthesia. Another, a boy of 15 years, had a gangreneous appendix removed under nitrous oxid-oxygen and local because of a history of smothering attacks, said to be asthmatic.

In no one of the 11 cases was there any anxiety during the anesthesia, any cynosis, excessive mucus or respiratory difficulty. It is perhaps worthy of notice that 5 of the cases had some condition which might be considered to point to an excitable or an excited nervous system, and in none was there any difficulty or sign of distress during the anesthesia.

CHARACTERISTICS OF MASSIVE LUNG COLLAPSE.

So far, in the cases recognized as such, the collapse has been confined to one side of the chest, five on the right and five on the left side. A bilateral collapse, as extensive as that seen in some of the radiograms, must necessarily have proved fatal.

Ten out of the eleven cases cited in this paper may be fairly offered as illustrative of the condition first described by Pasteur in 1890. In five patients, who had died from diphtheria complicated by paralysis of the diaphragm, Pasteur found and described as massive collapse, a peculiar airless condition of the lung, which was not penumonia. Subsequent papers called attention to the condition clinically and as a postoperative complication. During the war the matter again came into active discussion. This aspect of the question has been fully discussed in a paper by John Rose Bradford in the *Quarterly Medical Review*, 1918-1919, and massive collapse of the lung, as a clinical entity, has been fairly well established since that time.

The *onset of symptoms* occurred in all the cases herewith reported within the first 24 hours; usually within the first 12 hours, and local signs of lung involvement were recognizable within 36 hours, or usually in less than 24. *The symptoms were short, rapid respiration; respiratory distress; orthopnea, pain in the affected side, cough and expectoration. The cough was painful; the expectoration thick mucoid and in four of the cases blood stained. The acute distress varied considerably in degree and lasted from 3 to 5 days. In three cases it terminated suddenly. There was in all cases a sudden sharp rise in temperature varying from 100° to 104°. This fever lasted until the relief of the distress and sometimes dropped suddenly, sometimes gradually.*

Of the signs one is above all characteristic. A displacement of the heart toward the affected side. This was present in ten of the eleven cases and is considered as as essential factor in the diagnosis. With this it was noted that the affected side of the chest was smaller and the respiratory movements markedly less free than on the sound side. The breath sounds were suppressed at first, then became blowing in character. The displacement of the heart was in some cases, especially when the collapse was on the left side, quite small and not always easy to determine. In other cases, especially on the right side, the displacement was surprisingly great. The heart dullness had disappeared from the left side.

VALUE OF RADIOGRAPHIC STUDIES.

The radiogram was of the greatest service, both as confirmation of the clinical signs and as a photographic record of the daily changes in the position of the heart and the condition of the lung.

This record showed in varying degree a constant picture of a lessened lung volume on the affected side; the ribs close together; the diaphragm high and the heart displaced. The lung showed a density involving sometimes a small area at the base, sometimes the whole lung to the apex.

The outstanding feature in the case histories were the absence of any evidence of lung complication during the operation or during the first 8 to 10 hours after operation, the sudden onset of symptoms at the end of that period, but within the first 24 hours; and the remarkable change noted in three of the cases at the end of the second or third day. In these the improvement was extraordinary. All pain and respiratory distress had disappeared, the cough was lessened; the temperature and pulse were lower. On examination the dull area in the lung had become resonant, the movement of the chest was free and the heart had returned toward its normal position.

Radiograms were taken in 9 of the 11 cases. In 7 daily plates were taken from the time the condition was recognized to the time when the chest had returned to normal. This covered a period of from 8 to 12 days. As the first 7 cases have been reported in an earlier paper they will not be detailed here.

ADDITIONAL CASE REPORTS.

CASE 8.—H. D., aged 30. Patient was operated on in the R. V. H., November 15, 1920. A gangrene-

ous appendix, surrounded by a small abscess, was removed from the outer side of the cecum. The abdomeen was closed with a small drain. The anesthetic used was nitrous oxid-oxygen followed by open ether. It was well taken. On November 16, 20 hours after operation he was found suffering from pain in the right side. There was considerable respiratory distress, with cough and thick blood stained sputum. Temp. 102°, pulse 120, resp. 30. On examination the right side of the chest did not move freely; the heart was one inch to the right of the right sternal border and fully one inch inside the left nipple line. There was dullness at the base of the right lung with diminished breath sounds over the same area. His symptoms gradually improved until November 19 all signs and symptoms had disappeared. The radiograms showed an area of density at the right base and a moderate displacement of the heart to the right.

CASE 9.—J. L., aged 28. Patient was operated on for the cure of a left sided inguinal hernia. The sack was empty and there were no adhesions. A Bassini operation was performed. The anesthetic used was nitrous oxid-oxygen followed by open ether. It was well taken.

At 12 P. M., 10 hours after operation, he developed a cough, great respiratory distress with cyanosis accompanied by frothy expectoration.

Examination the following morning showed the temp. 102°, pulse 160, resp. 40. He was cyanosed, orthopneic, and in great distress with profuse expectoration. The sides of the chest moved nearly equally. There was no dullness; breath sounds were diminished at the base and numerous moist râles were to be heard on both sides. The heart was not easily marked out, but it was thought not to be displaced. His symptoms rapidly improved and by January 18, four days after the onset, all signs and symptoms had disappeared.

Radiograms showed a marked density in the right chest; no displacement of the heart and no diminution in the size of the lung. This case was not considered to be collapse. The reason for its inclusion will appear later.

CASE 10.—S. B. aged 21. Patient was operated on for an acute gangreneous appendix on April 9, 1921. The appendix was removed and the abdomen clo ed with drainage. He was moderately ill. The anesthetic used was nitrous oxid-oxygen followed by open ether. He struggled violently during the induction of the anesthesia. Ten hours after his condition was satisfactory except that his pulse was rapid (130). About 15 hours after operation he developed cough and expectoration with respiratory distress. Examination showed the temp. 100°, pulse 160, resp. 30. The right side of the chest did not move freely. The right diaphragm was high and the heart was somewhat to the right. There was dullness at the right base behind with diminished breath sounds. On the next day he was examined by a physician who reported that he had the signs of pneumonia at the right base, but did not look like a pneumonia patient.

On the third day he became much easier, and by the fourth day all signs of collapse had disappeared. The radiogram showed a moderate displacement of the heart and a density at the right base which did not clear as quickly as in some of the other cases.

CASE 11.—G. B., aged 13. Patient was operated on for a gangreneous appendix on March 10, 1921. The appendix was removed and the abdomen closed with drainage. On account of a history of asthmatic attacks local anesthesia, 0.05 per cent novocain was used with nitrous oxid-oxygen. The anesthetic was noted as satisfactory. Twelve hours after operation his temperature rose to 104° and he began to suffer from pain in the left side, cough and respiratory distress. Examination showed orthopnea, slight cyanosis, and respiratory movements, less on the left than on the right side. Temp. 104°, pulse 140, resp. 40. Atropin was given. Examined the same day breathing was still difficult but cyanosis less. The cardiac dullness was found on the right to the left border of the sternum and to the left one and a half inches outside the nipple line. The *x*-ray confirmed the high diaphragm, the displaced heart and showed a dullness a tthe left base. On the next day he was much improved; breathing was quiet. Temp. 100°, pulse 120, resp. 30. On March 14, the fourth day, the temperature again rose to 102°; the cough increased, the expectoration became more profuse, and the signs at the left base persisted. On March 21, 22 and 23, his condition improved and the signs cleared at the left base. This case was believed to be a case of primary collapse followed by consolidation or the development of pneumonia.

Case 9 has been included in this series because, in many respects, its course resembled the others both in the time of onset, the clinical symptoms and the dullness at the base of the lung and the density to the *x*-ray. It is to be differentiated from the collapse cases in that there was no displacement of the heart, recognized either by the ordinary methods of examination or by the radiogram. A density such as that shown in the first plate on the right side of the chest if due to a collapse would certainly have been accomplished by a considerable displacement of the heart toward the right. The condition of the lung was probably an edema and not consolidation; because it appeared and disappeared more rapidly than could a consolidation be expected to do. It is interesting to note, if this is true, that an edema of the lung can produce a density of that degree.

DISCUSSION.

Those, who have written on the subject of massive collapse of the lung, are in general agreement as to the symptoms, physical signs and the appearance as shown in the radiogram, but no satisfactory explanation of the condition has been offered.

The view generally held is that suggested originally by Pasteur, that the collapse is primarily due to a

paralysis, reflex, or otherwise, of the diaphragm, resulting in a loss of function of the adjacent lung.

This passive collapse of the lung, as the result of an inactivity of the diaphragm, does not explain the physical state found in these cases. If, on the other hand, a considerable decrease in the volume of the lung can be brought about in the closed chest cavity, the surrounding walls must approach each other to lessen the size of the cavity in exact proportion to the decreased volume of the lung. In other words, the diaphragm must rise, the mediastinum must press over toward the affected side and the thoracic wall must assume the position of expiration. It need hardly be said that the lung contains much elastic tissue, but the only muscular elements which could affect the problem, are the rather scanty circular smooth muscle fibers in the walls of the bronchioles. These structures are not rigid tubes and are not supported by cartilage. If these air passages could be obstructed sufficiently by contraction of the circular muscle aided perhaps by the collection of thick mucus, which is constantly present in these cases, for even a few hours, the air contained in the alveoli would be quickly absorbed and the elastic element in the lung would be unopposed. There is therefore a mechanism which might be sufficiently powerful to produce the condition found, if it could be brought into play.

It is known to physiologists that the sack-like lung of certain amphibans can be made to expand and contract through stimulation or cutting of the vagus nerve. It has recently been shown by Carlson that this reflex can be set up in frogs and turtles by stimulation of peripheral nerves in the nasal passages, the small and large bowel, kidney, and bladder. Experiments by the author have shown that ligature of the small bronchial branches with the lung expanded will result, after a delay of a few hours, in local areas of collapse roughly corresponding to the branches ligated. The collapse does not appear at once and must be due to the absorption of the distal air.

Such observations seems to offer at least a possible explanation by which the abdominal interference may, through a normal vagus control, cause a contraction of the muscular elements in the lung, aided by a collection of mucus, sufficient to prevent the passage of air beyond the obstruction. Should this be maintained for a few hours the absorption of the air beyond the obstruction would produce the condition known as collapse. It would also explain the sudden relief of symptoms and the sudden disappearance of pathological signs noted in three of these cases.

SOME STUDIES OF THE BLOOD BEFORE AND AFTER ETHERIZATION BY THE DROP METHOD.*

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The present study of the blood was prompted by an untoward result of anesthesia which came to my knowledge. A young man in the prime of life went into a hospital for a slight operation; within the first twenty-four hours after the etherization his temperature went to 105° F. and he died in a few days from so-called *ether pneumonia.* As I looked into his dead face, which I had seen only two weeks before, full of life and animation, this question came into my mind,—What did the ether do to him?

Upon my return to my own home I talked the question over with Mark O'Meara, Chief of Staff at the Benedictine Hospital, who gave me most hearty encouragement and opportunity to study the blood of patients in his service in the hospital.

METHOD OF STUDY.

The smears were made with cigarette paper and stained with Wright's stain, 200 counts being made. The hemoglobin was determined by means of the Tallquist scale, the blood pressure by Baum's sphygmomanometer. Squibb's ether was used, and in all cases, unless contraindicated, from one-fourth to one-eighth grain of morphin with one-hundred and fiftieth grain of atropin was given half an hour before the ether.

My method of procedure was the following:—Usually on the table the blood pressure readings and hemoglobin index were taken and recorded and smears made; the anesthetic was administered and at the close of the operation the process was repeated.

These patients came from all over our county of about 80,000 population, with but two general hospitals for the entire county and both located in Kingston. The operations were for a variety of conditions and were upon patients of all ages from two years to seventy.

STATISTICAL RECORDS.

The following table gives the numbers by age decades and the conditions for which the operations were done, on 100 patients.

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921. From the Service of Dr. Mark O'Meara, Chief of Staff, Benedictine Hospital, Kingston, N. Y.

TABLE I—AGE GROUPS BY DECADES.

Decade	No. Patients	Surgical Operations	No.
1	4	Appendectomies	45
2	7	Hysterectomies	3
3	23	Amputation of Cervix and Perineorraphies	15
4	31	Cholecystectomies	7
5	18	Ovariotomies	8
6	13	Herniotomies	4
7	3	Miscellaneous	18
8	1		
Total	100		100

In Table I the appendectomies are all counted together, fully half of them were for gangrenous appendicitis and most of these were night emergency operations. The 18 miscellaneous procedures were made up of a variety of operations among which were two for ectopic gestation, two prostatectomies and two for fractured patella.

The amount of ether varied from three ounces in eight cases to ten ounces in one case. The average was between five and six ounces. The time of etherization varied from fifteen minutes to two hours. The average was from forty-five minutes to one hour.

Table II gives the changes shown in the differential counts of this 100 patients, as shown by contrasting the counts made just before and immediately after etherization, also hemoglobin index and blood pressure readings.

TABLE II.

RESULTS	Lymphcytes Small	Lymphcytes Large	Transitional Large Monnuclears	Polymorpho-nuclears	Eosinophiles	Basophiles Mastcells	Leucocytosis	Hemoglobin	Blood Pressure	Blood Platelets Erythrocytes
Unchanged	8	8	11	5	34	51		97	6	Unchanged
Increased	55	60	37	30	35	25	100	1		in
Decreased	37	32	52	65	31	24		2	94	Appearance

The results in Table II, to my surprise showed no uniformity. The blood pressure was maintained six times. There were cases in which the abdominal condition, when relieved, seemed to offset the usual depressing effects of etherization and operation. One case of ectopic gestation showed this peculiarity and one of hernia which was caught in the ring internally. This also seemed to be the case with some of the children brought in from the country with gangrenous appendicitis. The parents in the country sometimes delay sending for a physician as long as possible and frequently on the first visit of the physician he tells them that an operation is the only thing which can save the child's life, and he brings the little patient into the hospital, desperately sick and nearly frightened to death. If there is such a thing as psychic shock such patients have it.

Of these 100 patients 97 recovered and three died. One who died was an elderly man brought to the hospital in the night in a desperate condition. His blood pressures were sys. 110, dias. 70, hb. 80. Four ounces of ether were used. The abdomen was full of pus, drainage was put in. His blood pressure at the close was sys. 65, diast. 30, hb. 80. Before leaving the table an enema of one quart of warm water with one drachm of sodium bicarbonate was put high in the rectum with the patient in the slight Trendelenburg position. This is the rule with all of our patients if the blood pressure has fallen more than 10 mm. at the close of an operation. In spite of all efforts to save him he died on the second day. This man's blood cells, both red and white, were poor in appearance; the white flabby looking as though they were ready to fall apart, and the red crenated and distorted. The cells had this appearance before as well as after the operation. In the count polymorphonuclears were 78 per cent. before and 76 per cent. after the operation. In our experience, greatly increased polymorphonuclear count usually indicates pus.

Another fatal case was a woman brought into the hospital with an enlargement in the right side, with albumen in the urine. Her blood pressure before operation were sys. 130, dias. 110, hb. 80. When the abdomen was opened an inoperable mass was disclosed; drainage was put in and the abdomen closed. The blood pressures were then sys. 80, diast. 70, and hb. 80. She died in about 12 hours. Her red and white cells were both very abnormal in appearance. In the differential count the polymorphonuclears were 59 per cent. before and 60 per cent. after.

The third fatal case was a woman 38 years old, in whom the diagnosis was not clear. Her blood pressures were sys. 115, diast. 80, hb. 70. When the abdomen was opened double ovarian cysts were found, the right of considerable size, with a twisted pedicle and the whole mass appeared gangrenous. Both cysts were removed and drainage put in. The operation lasted 40 minutes and 5 ounces of ether were used. At the close her blood pressures were sys. 95, diast. 60, hb. 70. Her polymorphonuclears were 74 per cent. before and 65 per cent after. In general appearance the red and white cells were

TABLE III.

BLOOD CHANGES IN PATIENTS OPERATED ON UNDER LOCAL ANESTHESIA WITH 0.05 PER CENT COCAIN.

Case	Surgical Condition	Blood Pressure	Hemoglobin	Lymphocytes Large	Lymphocytes Small	Mononuclears	Polymorphonuclears	Eosinophiles	Basophiles	Blood Platelets Erythrocytes
1	Hernia-Pregnant 4 months	B Sys. 110 Dias. 80	85	3. %	3. %	2. %	65.	0.	1. %	Unchanged in Appearance
		A Sys. 85 Dias. 60	85	2.5%	7. %	3.5%	64.5	0.	0.5%	
2	Hernia and Bronchitis	B Sys. 120 Dias. 110	90	8.5%	13. %	6. %	70.	1.	0. %	
		A Sys. 110 Dias. 90	90	8. %	16. %	6.5%	69.5	1.5	0. %	
3	Postoperative Hernia	B Sys. 110 Dias. 80	70	26.5%	3. %	0. %	68.	1.5	1. %	
		A Sys. 95 Dias. 65	75	2.5%	12.5%	2.5%	80.	1.	0. %	
4	Septic Phlebitis and Appendicitis	B Sys. 110 Dias. 80	80	5. %	4. %	1. %	90.	0.	0. %	
		A Sys. 80 Dias. 50	80	9. %	5. %	1. %	82.	0.	0.5%	
5	Prostatectomy Died	B Sys. 170 Dias. 130	85	24. %	7. %	2. %	72.	1.	0.5%	
		A Sys. 125 Dias. 90	80	23. %	8. %	0.5%	64.	1.	1. %	
6	Prostatectomy	B Sys. 155 Dias. 110	85	8.5%	8. %	4. %	78.	1.	1. %	
		A Sys. 120 Dias. 90	85	8. %	11. %	7. %	72.5	1.	0.5%	

more normal than in the other two patients who died. This patient became paralyzed in both legs and died in about three weeks. It was then learned that she had previously suffered from some spinal cord trouble.

From a study of the blood of these patients who died, I am convinced that the appearance of the cells, both red and white, has a good deal of prognostic value.

The differential count in this series of 100 patients, did not show the uniform changes which I had expected to find, as J. O. Polak has reported an average increase of 14 per cent. polymorphonuclears after operations in his clinic; and F. C. Mann has reported an increase of the same cells after long etherizations in dogs.

I found among my records six cases of operation under local anesthesia in which a solution of 0.5 per cent. cocain was used. For one reason or another general anesthesia was contraindicated. I studied these cases with a good deal of interest for the ether effects were entirely eliminated.

Of the six patients, 5 lived and 1 died. In every instance there was a fall of blood pressure. In four cases the hemoglobin was unchanged; one increased 5 per cent., one decreased 5 per cent. In five cases the polymorphonuclears were slightly decreased and in one case increased 12 per cent. The man who died after prostatectomy was 65 years old; his urine showed albumen, red cells, many of them distorted and crenated as well as white cells, large and flabby looking. The cells had this appearance both before and after the operation. His polymorphonuclears were decreased 8 per cent. after the operation. He seemed to do fairly well for a few days; but died a short time later from failure of kidney function.

COMPARISON OF RESULTS.

From a comparison of the results obtained in the study of these operations, with or without ether (for the length of time and average amounts used) it seems to me that ether had slight effect on the blood as determined by the microscopic studies.

The importance of preoperative study of patients was impressed upon me by the patient to whom I gave ten ounces of ether. I had never seen the patient until I took her blood smears and administered the ether, the operation was for amputation of the cervix and repair of the perineum, which the surgeon usually completes within an hour. The operation was practically completed as usual; but there was so much oozing of blood that the second hour was consumed in controlling it. Fortunately the patient made a good recovery. *But when I came to examine the smears I noticed almost a complete absence of blood platelets. I did not at the time know the significance of this, but I soon learned that the platelets were supposed to have influence over the clotting power of the blood. Since then to patients, whose blood shows a great deficiency in appearance of blood platelets, we give calcium chlorid in drachm doses four times a day for two or three days before*

operating. H. C. Gram, of Stockholm, considers that a count of blood platelets below 200,000 *per cmm. shows a great predisposition to hemorrhage. Stitt gives the normal number as* 350,000 *per cmm.*

In discussing this series of cases with Dr. O'Meara we both concluded that at least two of the 97 patients who lived, would probably not have done so, except for the preoperative study and care. One was a patient, in poor condition, brought in for immediate hysterectomy. The other was a frail woman who was operated on for an amputation of the cervix and perineorrhapy, whose blood showed very few platelets.

FREE FAT IN THE BLOOD.

In the laboratory of Cornell University, at Ithaca, some very interesting studies have been made recently on the free fat in the blood by means of the dark field microscope. These studies have been made on animals and on human beings of all ages to determine the normal fat particles or chylo-microns present during the digestive cycle. The appearance during fasting and after a full meal is shown in Fig. 1.

I was asked to make some observations on patients before and after ether anesthesia to see if there was any change in the number of fat particles due to the ether; that is whether there was what has been reported as an *ether lipemia,* by Bloor and Mann, who made their separate studies upon dogs, and their determinations by the chemical method. In the standard descriptions of lipemia (Osler's for example) the blood serum is found milky from the number of fat particles in it. It was thought that if there were any ether lipemia in a man during the

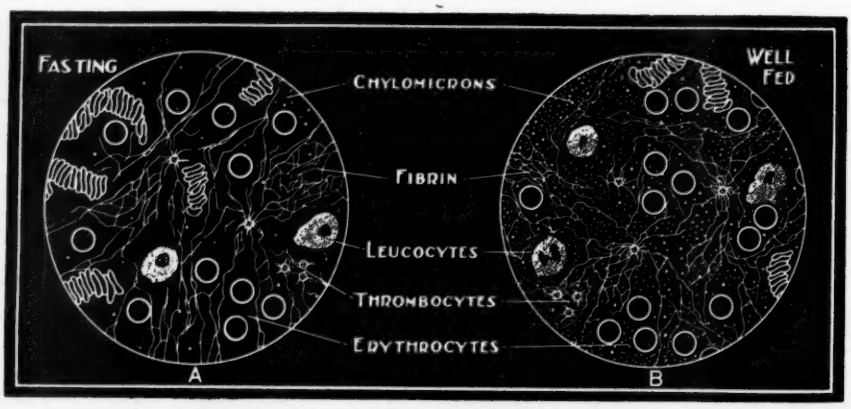

Fig. 1. Fresh Human Blood as seen by the Dark-field Microscope. *A.* After a fast from fatty food of 12 to 24 hours. There are very few fat particles (chylo-microns) present. *B.* Three to four hours after a full meal with plenty of fat. The chylo-microns or fat particles are very abundant. (From S. H. Gage.)

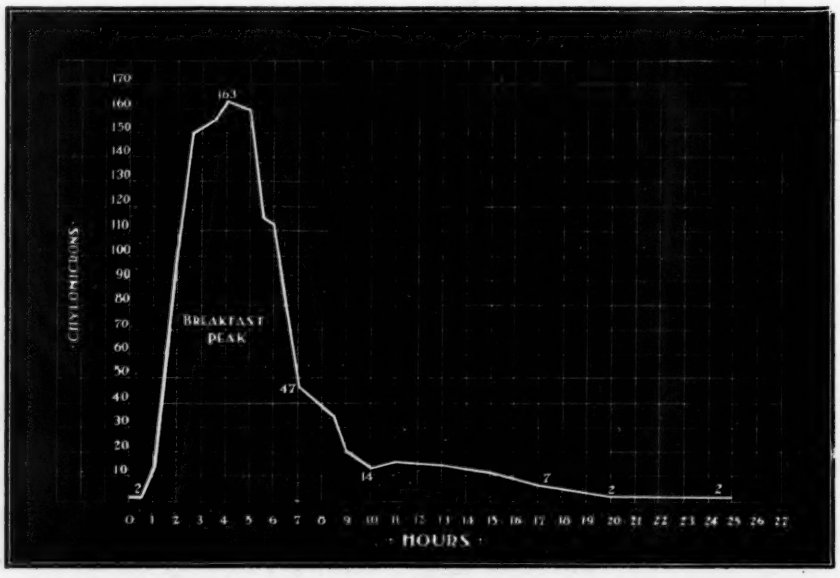

Fig. 2. Curve of the Digestive Cycle of Fat in Man. But one meal (breakfast) was taken in 24 hours; it contained 40 grams of butter and plenty of bread and baked potatoes. The horizontal lines represent the time in hours; the vertical lines represent the number of chylo-microns or fat particles per field in the dark-field microscope at different stages of the digestion. (From S. H. Gage.)

period of operation, it would be easily detected by the dark-field microscope method, which only requires a small drop of blood taken from any part of the body.

The nine patients examined (the etherization period ranging from 35 minutes to one hour) showed, in each case, a *decrease* in number of the fat particles in the blood, *not an increase*. Three typical cases are shown in Figure 2, in which the upper full line represents the free fat particles before the ether, and the broken line below shows the smaller number after the operation.

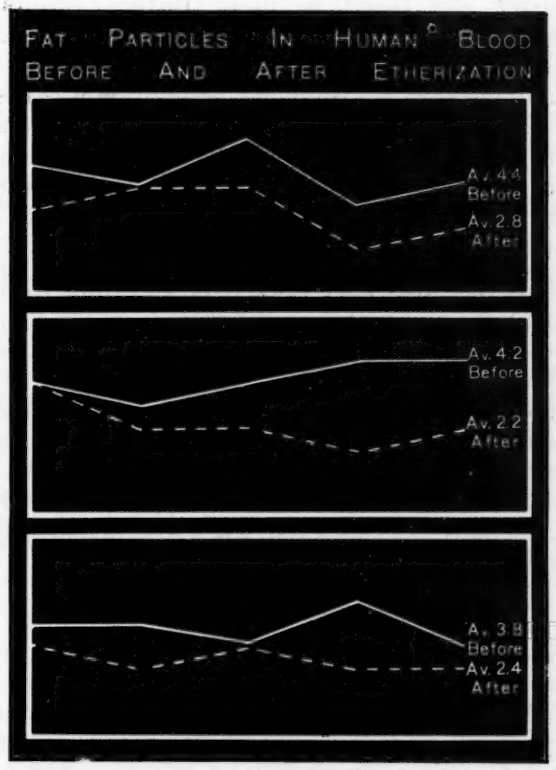

Fig. 3. Curves Showing Fewer Fat Particles in Human Blood after Etherization than Before. (Dr. Mary Gage Day.)

CONCLUSIONS.

From these observations it can be stated positively that the free fat in the blood of man is not increased by etherization for operations, not over an hour long, and not requiring more than 5 to 7 ounces of ether.

In closing I wish to emphasize the points which these studies have made upon me.

1. The importance of more careful preoperative study of patients, especially the determination of hemoglobin, the blood pressure, the differential blood counts and the number of blood platelets.

2. The careful administration of ether to persons whose blood is in an approximately normal condition, for an operation skillfully performed under ether, is *without any marked detrimental* effect on the blood.

3. The studies so far made with the dark-field microscope do not show an increase of free fat in the blood due to etherization in man. And hence speak against Reicher's theory of anesthesia, as given in a discussion of this subject in Gwathmey's Anesthesia.

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LESSONS FROM ANESTHETIC ACCIDENTS AND NEAR FATALITIES.

RALPH M. WATERS, M.D.,
SIOUX CITY, IOWA.

Not coveting the reputation of *official crape hanger* among the anesthetists of North America I regret presenting sheets of sorry results for your consideration; but nevertheless as we read the program of this meeting there appears so much of good cheer and happy reports from the other anesthetists that perhaps the gloom cast by my efforts will be quickly dispelled by the whirlwind of success and sunshine which is to follow.

Every case which we are asked to anesthetize should, without fail, on every occasion be subjected to the following inquiry:

1. The last intake of food and its nature if recent.
2. The condition of the lungs and the heart, especially as to history and inspection.
3. Condition of the nose, of the mouth and of the throat (teeth, tonsils and respiratory obstructions.
4. The mental attitude and the stability of the central nervous system.
5. The general physical resistance as related to operation to be undergone, including, in all doubtful cases, careful observations of circulatory system reserve before and during anesthesia.

*Presidential Address presented before the Organization Meeting of the Mid-Western Association of Anesthetists in Joint Session with the National Anesthesia Research Society, Hotel Muehlebach, Kansas City, Mo., October 24-26, 1921.

Failure to make such an inquiry or to judicially consider its results has made necessary the relating of the following seven case histories as well as five other more serious accidents previously reported, (*American Journal of Surgery, Anesthesia Supplement,* July, 1920, Vol. xxxiv, No. 7, p. 76.)

CASE REPORTS——POSTOPERATIVE PNEUMONIA.

CASE 1.—Male, aged 38; clinical diagnosis ruptured duodenal ulcer five hours previous. After the operation a history of pulmonary tuberculosis, only recently arrested, was obtained. He died three days later from pneumonia. He was given a late preoperative sedative and that containing atropin. Extreme rebreathing, respiratory stimulation and ether anesthesia were used when he needed quiet, shallow respiration with no lung irritation. A history or a physical examination would have warned us.

PERITONSILAR ABSCESS.

CASE 2.—Female, aged 27; obese and thick necked; operation left mastoidectomy. A swelling of the left neck was explained by the surgeon as a Bezold's abscess. A metal airway was inserted to relieve respiratory obstruction so commonly encountered in short neck individuals. Some force was required to slip the airway over the tongue. When it was removed the pharyngeal portion was covered with pus. Inspection of the throat showed a rather neat incision in a peritonsillar abscess on the left side. Her pneumonia was of only thirty-six hours duration. A hurried mouth inspection would have saved this woman's life.

HYSTERICAL BLINDNESS.

CASE. 3.—Female, aged 30; operation removal of an impacted third molar tooth. She was thoroughly frightened. The operation required forty-five minutes. When the patient was partially recovered from anesthesia the dentist allowed a sponge coated with blood and mucous to slip back into the glottis, causing temporary respiratory obstruction with deep cyanosis until I removed it by a blow on the patient's back. The husband was present. Fifteen minutes were required before consciousness was completely regained.

After four days of apparently normal convalescence this woman awakened in the night with an attack of vomiting and found difficulty in moving her right arm. The next morning she said she could only distinguish light but that the arm was recovered and it remained so. The partial blindness persists after three years. The diagnosis by a neurologist whom I asked to see her was *hysterical blindness.* An ophthalomologist gives the opinion that "she may have definite pathology along the optic tract somewhere." This result is one of partial blindness after anesthesia which might have been prevented by appreciating the mental disturbance of the patient, sending her to a hospital beforehand and using a sedative drug previous to the anesthesia. Needless to say *I hove not, since that day allowed a dentist to use a small sponge* of the kind then used.

VAGUS TRAUMA.

CASE 4.—Female, aged 15; mental grade 7 to 8. Operation tonsillectomy and adenectomy. Nitrous oxid-oxygen induction followed by ether-air maintainance. At no time were the pupils dilated and a *roving* eye-ball was present during the latter half of the operation. Ether discontinued one and a half minutes before end of operation. Patient was charged to prone from lateral position in which the operation was done, and moved to the hospital cart. In transferring her to the cart my wrist was under her neck and as the transfer was made her head rolled so that my wrist undoubtedly met the soft parts of the side of her neck rather forcibly. After the transfer she failed to make further respiratory efforts. Peripheral pulse was not palpable. Schaefer manipulations were continued over a period of five minutes before voluntary respiration was resumed. The color had been very bad, a greyish cyanosis. Pure oxygen was given for three or four minutes after recovery during which time the respirations were slow but efficient. No further difficulty presented.

This case was later gone over carefully with the fluoroscope and plates of the chest to check the previous negative physical examination and no abnormalities were found. Your opinions are solicited as to the cause of respiratory and circulatory arrest in this instance, mine being that trauma to the vagus occurred in transferring her from table to cart. We should be extremely cautious and gentle in moving anesthetized persons even when the actual relative position is not to be changed.

CEREBRAL HEMORRHAGE.

CASE 5.—Male, aged 56, operation cystoscopy. Cachectic and anemic. Nitrous oxid-oxygen used without preoperative medication. Withdrawal of the instrument at the end of operation caused struggling, followed immediately by collapse. Pulse disappeared, then pupils dilated and lastly respiration ceased. Immediate heart massage and lung inflation with oxygen under low pressure brought recovery in order of disappearance. The pulse became palpable after two or three minutes; the pupils contracted next and normal respiration was resumed after ten minutes. Oxygen was inhaled for one-half hour with some rebreathing. Six hours later he recovered consciousness. His speech was thick and difficult, face muscles twitching and head turned to right. Lower limbs later proved to be partially paralyzed. This was very likely a cerebral hemorrhage occurring during anesthesia. Whatever occurred I committed several errors in my efforts. *First,* preanesthetic blood pressure observations were not taken. These readings would have been interesting and without doubt useful in showing the wisdom of postponing anesthesia. *Second,* no sedative was ordered, making struggling during induction and recovery more likely. *Third,* the patient was forced out of bed to walk to the operating room instead of being transferred on a cart.

VALUE OF M'KESSON'S RULE FOR SHOCK.

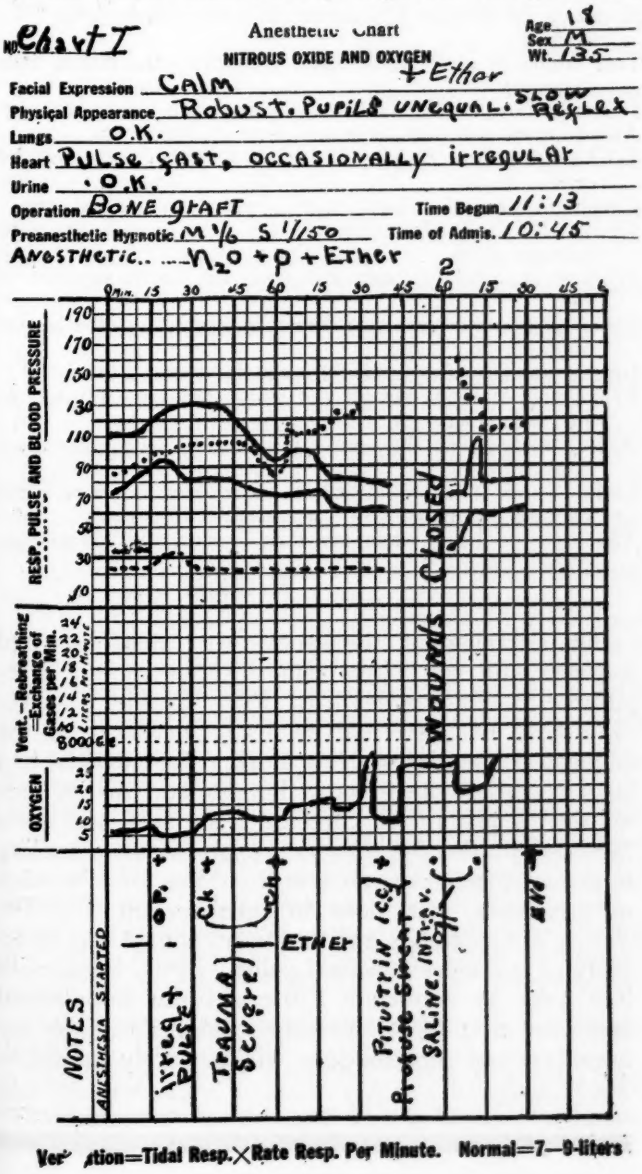
The next two cases illustrate the value of the McKesson rule:—*"With a pulse rate of 120 or more, a pulse pressure of 20 millimeters of mercury or less and a systolic pressure of 80 m.m. or less, in a patient, who, at the beginning of operation, had presented normal pressures, frank shock has occurred. If these low pressures are continued without improvement for more than one-half hour, a vicious circle is generally established which, without treatment, will cause the death of the patient within three days."*

CASE 6.—Male, aged 18; operation bone graft from left tibia to right femur on Hawley fracture table, with extreme extension. The boy was robust except for an old fractured femur and accompanying suffering. Physical examination was negative except for unequal pupils with sluggish light reflex and a fast pulse, occasionally irregular. Nitrous oxid-oxygen anesthesia was used, supplemented with rather large quantities of ether, thought necessary for relaxation. *Note the development of frank shock allowed to continue over one-half hour without treatment.* No response to 1 cc. of pituitrin (surgical) within fifteen minutes. One quart of normal saline intravenously improved the pressures and pulse rate somewhat. Recovery very stormy demanding extreme treatment for shock repeatedly during ensuing twenty-four hours. Eventual recovery good.

CASE 7.—Female, aged 25. Operation pan-hysterectomy for carcinoma of fundus. Previous severe bleeding with secondary anemia. *Note frank shock not allowed to continue one-half hour without treatment.* Off table without shock and recovery satisfactory without further treatment.

The first chart (Case 6) is that of a healthy boy, handicapped only by previous suffering, who was almost lost through our transgression of McKesson's Rule; while the second chart (Case 7) that of a woman, handicapped by previous long continued hemorrhage and consequent anemia, shows the patient in no danger because of a strict interpretation of the rule.

In conclusion then let us practice using a *seeing eye* and a *hearing ear* and digest the facts they bring us with a judicial mind. Proper interpretation of a careful physical examination and data secured during anesthesia is the anesthetist's best insurance against casualties. 107 GILMAN TERRACE.



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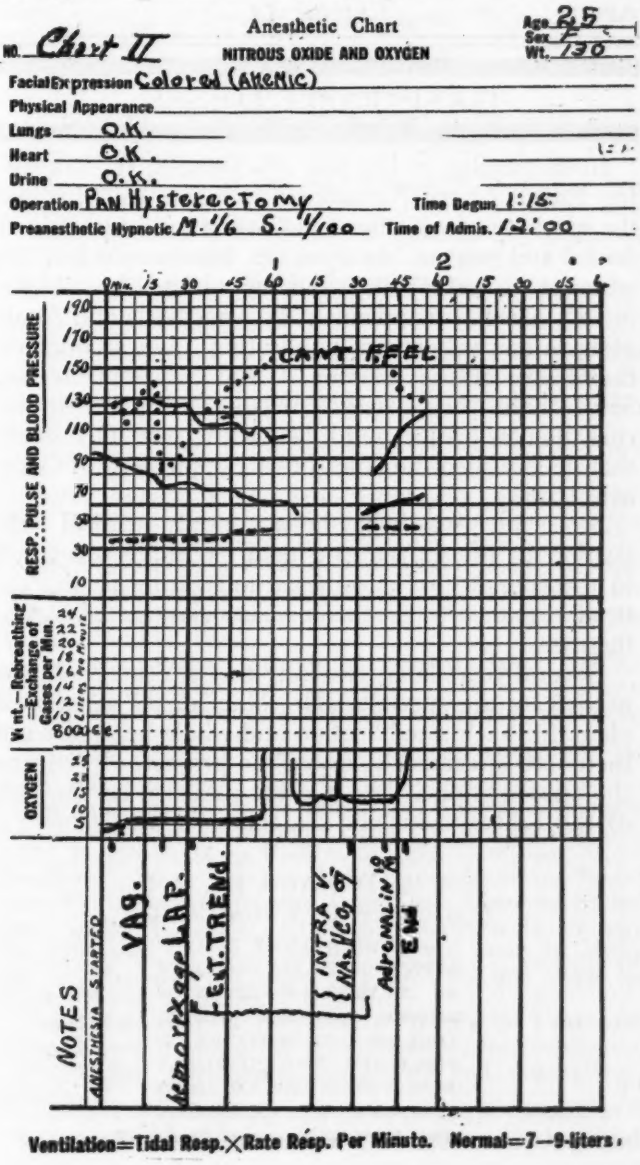

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American Journal of Surgery

QUARTERLY SUPPLEMENT *of* ANESTHESIA *and* ANALGESIA

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

APRIL EDITORIALS 1922

IRREPARABLE LOSSES.

In the passing of Dr. Jos. MacDonald, Jr., Managing Editor of the AMERICAN JOURNAL OF SURGERY the specialty of anesthesia has lost a tried and valued friend and patron. In 1914 Dr. MacDonald had the editorial vision to accept the suggestion of establishing a Quarterly Supplement of Anesthesia and Analgesia in his well-known publication. On account of the illness of the Editor of the Supplement, Dr. MacDonald made a special trip to Cincinnati to discuss the new project and it was with great enthusiasm that he launched the Anesthesia Supplement in October, 1914.

Since that time it has been the only medical publication in the journalistic field exclusively devoted to the specialty of anesthesia and acting as the official organ of the various Associations of Anesthetists.

Several years later, realizing that a Year-Book was needed by the specialty, Dr. MacDonald sanctioned plans for such a publication and whole-heartedly put them into effect and financed the project. In editing the 1921 edition it was a great pleasure on the part of the Editor to include the following dedication:

To
JOS. MacDONALD, JR., M. D.
(*Late Major, U. S. Army M. C.*)
THIS VOLUME IS
AFFECTIONATELY DEDICATED
AS A FRIENDLY TOKEN OF
REGARD FOR HIS VISION,
COURAGE AND INITIATIVE IN
PUBLISHING THE QUARTERLY
SUPPLEMENT AND AMERICAN
YEAR-BOOK OF ANESTHESIA
AND ANALGESIA —*The Editor.*

It is a pity that Dr. MacDonald could not have lived long enough to have brought his patronage of the specialty of anesthesia to full fruition as he had a separate American Journal of Anesthesia and Analgesia in contemplation. The Editor is quite sure that the Associated Anesthetists of the United States and Canada, who knew of Dr. MacDonald's efforts in their behalf, join in a vain effort to find words in which to express adequately their feeling of loss. In some way, no doubt, they will try and pay him a proper tribute.

If anesthesia is coming into its own, if those who must undergo the ordeal of surgical operation are more comfortable and safer in so doing, if the Associations of Anesthetists are covering the entire country and if the specialty has been given a journalistic outlet, it has been due to the vision of him, whom we mourn, and all these accomplishments stand as an imperishable monument to his memory.

Perhaps the following lines express the sentiments of those who are nearest to Dr. MacDonald i. his life and work, better than anything else could:

GOD'S AMEN!

To Joseph MacDonald, Jr., M.D.

It cannot be that he has passed into the Land-of-the-Far-Away;
This friend of mine whose hand I clasped—and talked with yesterday!
I see him now, his face aflame, glowing with joy to be again
Able to work and play the game, even as other men.
All he asked was to play his part, to finish the work he craved to do,
Keeping faith with a loyal heart, always staunch and true
And so he lived. But who can tell how he suffered with courage grim,
Waiting the Call he knew full well was bound to come to him.
Other men would have been dismayed, crushed by the weight of doubt and fear;
But he was a soldier unafraid, even tho' death was near.
Brave and fearless, he did not shirk, but gave himself to his fellowmen,
Asking naught but the boon of work, 'til God should say "Amen."
God's "Amen"! I would ask no more than to know I had as surely won
The right to hear, when my task is o'er, the Master say "Well Done"!

H. Edwin Lewis, M.D.

The Supplement, the specialty of anesthesia and the scientific world has also suffered another irreparable loss in the death of Prof. Charles Baskerville, head of the Department of Chemistry of the College of the City of New York. For years he had been accorded the greatest honors and distinctions within the gift of his chemical associates, and anesthetists had also come to look upon him as a leading figure in their research world. Most of his work in anesthesia was done in collaboration with Dr. James T. Gwathmey and on this account it was invariably of intensive practical value. Prof. Baskerville had been an Associate Editor of the Supplement from the time of its inception and his valuable cooperation and contributions will be sorely missed.—McM.

Society Proceedings

AMERICAN AND MID-WESTERN ASSOCIATIONS OF ANESTHETISTS.

The American and Mid-Western Associations of Anesthetists will hold a Joint Meeting at the Hotel Jefferson, St. Louis, May 22-24, 1922. The following may be mentioned among the important papers and speakers:

Address of Welcome. Vilray P. Blair, St. Louis.

Currents in the Progress of Anesthesia. David E. Hoag, Pueblo, Col.

Anesthesia in Children: Safest Methods and Agents. Frances E. Haines, Chicago.

Toxic By-Effects of Hyoscin and Scopolamin and Estimating the Narcotic Dosage for Children Before Tonsil Operations. Ralph M. Waters, Sioux City, Iowa.

Observations on Anesthetic Service in 100 American and Canadian Hospitals. A. E. Peebles, Wilmington, Ohio.

Anesthesia as an Antidote to Botulinus Poisoning. Jacques Bronfenbrenner, Boston.

Operative Shock: Glucose and Calcium Therapy. James V. Ricci and Lillian K. H. Farrar, New York City.

Calcium in Relation to Operation and Results in Obstructive Jaundice. Waltman Walthers, Rochester, Minn.

A Review of Synergistic Anesthesia. James T. Gwathmey, and James Greenough, New York City.

The Influence of the Operation and Anesthetic in Postoperative Complications. A. H. Miller, Providence, R. I.

The Method of Carrying Nitrous Oxid-Oxygen in the Blood and the Availability of Oxygen from Nitrous Oxid. C. W. Greene, Columbia, Mo.

The Ill Effects of Oxygen Insufficiency during Anesthesia. Eugene Cary, Chicago.

Oxygen Therapy. Alvan R. Barach, New York City.

Oxygen Therapy as a New Field for the Anesthetist. E. I. McKesson, Toledo.

The Scope and Value of Suspended Respiration as a Test for Surgical and Anesthetic Risk. Gilbert Fitz-Patrick, and T. Edward Costain, Chicago.

Circulatory Changes under Anesthesia. Morris H. Clark, Kansas City, Mo.

Some Unusual Anesthetic Experiences. Ansel M. Caine, New Orleans.

Case Reports of Unusual Conditions under Anesthesia. Edward H. Lane, East St. Louis, Ill.

Some Unusual Phenomena Following Nitrous Oxid-Oxygen Anesthesia. J. E. H. Attkeisson, Chicago.

The Tuesday afternoon program will be devoted to special Addresses:

The Theory of Anesthesia. Albert P. Matthews, Cincinnati.

The Cause and Treatment of Coma Following Anesthesia and Operation. Martin H. Fisher, Cincinnati.

During the Special Session on Anesthesia for Oral Surgery and Dentistry, in which the St. Louis Dental Society will participate, the following papers will be presented:

Pathological Conditions Due to Focal Infections in Relation to Anesthesia, Especially Nitrous Oxid-Oxygen. C. A. Barnhill, Indianapolis.

Anesthetics, Their Use and Abuse in Dentistry. Stephen Palmer, Poughkeepsie, N. Y.

Better Nitrous Oxid. George Seeman, Nashville, Tenn.

Obviating Postoperative Anesthesia Complications in Oral Surgery. Ralph H. Fouser, Salem, So. Dak.

Local Anesthesia for Oral Surgery during Acute Infections. Thomas L. Higginbotham, Wichita, Kan.

The American Medical Association has accorded the Associated Anesthetists a Special Anesthesia Session in the Section on Miscellaneous Topics. The following program will be presented:

Postoperative Lung Complications, (Chairman's Address). Isabella C. Herb, Chicago.

Complications of the Respiratory Tract Following Nose and Throat Surgery. Cline N. Chipman, Washington, D. C.

The Effects of the Repeated Administration of Anesthetics on Blood Catalase. W. E. Burge, Urbana, Ill.

Endocrine Exhaustion in Relation to Anesthesia and Operation. J. F. Corbett, Minneapolis.

Clinical and Experimental Studies in the Cerebro-Spinal Fluid Tension, in Relation to Surgical and Anesthetic Risk. Harry Jackson, Chicago.

Synergistic Analgesia. J. M. Rector, Jersey City, N. J.

Members can secure reduced railroad rates by applying for an identification certificate to Dr. Alex. R. Craig, 535 North Dearborn St., Chicago, and enclosing an addressed and stamped envelope.

For further information, membership and reservations, address:

F. H. McMECHAN, M.D., *Secretary*,
Lake Shore Road, Avon Lake, O., or
MORRIS H. CLARK, M.D., *Secretary*,
23rd and Holmes Sts., Kansas City, Mo.
Research Hospital.

PACIFIC COAST ASSOCIATION OF ANESTHETISTS.

The Pacific Coast Association of Anesthetists will hold its first scientific session as a Joint Meeting with the Section on Anesthesiology of the California State Medical Society, at Yosemite, California, May 15-16, 1922.

Among the most interesting features of the program may be mentioned the following papers and speakers:

Post-Tonsillectomy Pulmonary Abscess, (President's Address Section on Anesthesiology). Mary E. Botsford, San Francisco.

The Relation of Surgeon and Anesthetist. Saxon T. Pope, San Francisco.

Organization of the Hospital Anesthetic Department. Caroline B. Palmer, San Francisco.

Analysis of Anesthetics Given in 80 Consecutive Brain Operations at the University of California. Dorothy A. Wood, San Francisco.

The Clinical Use of Oxygen. Lorruli A. Rethwilm, San Francisco.

Spasticity from Inflammation in Relation to Anesthesia, (President's Address Pacific Coast Association of Anesthetists). George P. Waller, Los Angeles.

Time as an Element in Anesthesia for Children. Mary T. Murphy, San Francisco.

Anesthesia and its Relation to the Patient from the Surgeon's Standpoint: Type of Anesthesia and its Relation to Existing Pathology: Emoluments to the Anesthetist. Harlan Shoemaker, Los Angeles.

Suggestive Leads in Anesthesia. F. H. McMechan, Avon Lake, Ohio.

Sacral Anesthesia: A New Method of Administration with Report of Use in 400 Urological and Gynecological Cases. Albert J. School, Jr., Rochester, Minn.

Ethyl Chlorid as a General Anesthetic. Louise A. Oldenbourg, Oakland, Cal.

Anesthol, a Most Useful Anesthetic Mixture. Louis H. Maxson, Seattle, Wash.

The Physiological Effects of Nitrous Oxid. Neil C. Trew, Los Angeles.

Nitrous Oxid-Oxygen Anesthesia in Infants. Mary E. Botsford, San Francisco.

Symposium on Intratracheal Anesthesia. Mary Kavanaugh, San Francisco; Edith Williams, San Francisco.

The following will act as Officers and Executive Committee for the Yosemite Meeting: George P. Waller, Los Angeles, President; Mary E. Botsford, San Francisco, Vice-President; Eleanor Seymour, Los Angeles, Secretary-Treasurer; F. H. McMechan, Avon Lake, Ohio, Honorary Secretary; Walter R. Crane, Los Angeles, Caroline B. Palmer, San Francisco, Robert L. Charles, Denver, Louis H. Maxson, Seattle, Louise A. Oldenbourg, Oakland, and David E. Hoag, Pueblo, Executive Committee.

Anesthetists, medical and dental, of the Pacific Coast and Rocky Mountain States are urged to attend this meeting.

For further information, membership and reservations, address

ELEANOR SEYMOUR, M.D., *Secretary*,
1329 South Grand Ave., Los Angeles, Cali.

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(Continued from January issue.)

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LOCAL ANESTHESIA—QUANTITATIVE DETERMINATION OF COCAIN ABSORBTION BY AQUEOUS HUMOR. Lawrence Post, St. Louis. Journal American Medical Association, October 22, 1921.

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LOCAL ANESTHESIA—DANGERS OF CONDUCTING ANESTHESIA. L. Druner. Deutsche medizinische Wochenschrift. August 18. 1921

LOCAL ANESTHESIA IN DENTAL, ORAL, AND NOSE AND THROAT SURGERY. H. E. Tompkins. New York Medical Journal, October 19, 1921.

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THE SCOPE AND UTILITY OF ANESTHETIC MIXTURE.*

DAVID E. HOAG, M. D.
PUEBLO, COLORADO.

In studying the different text books on anesthesia, I have been quite surprised at the lack of attention giving *somnoform*. Both Hewitt and Buxton but lightly touch upon its virtues and almost condemn its use. Luke, an ethyl chlorid enthusiast, prefers the single agent to *anesthetic mixture*. Gwathmey, gives somewhat more information regarding the subject, but it was not until W. H. DeFord's exhaustive paper appeared in The American Year Book of Anesthesia and Analgesia (1915-1916) that the pharmaco-physio-pathology of somnoform, as well as the scope, utility and technic of its administration received the adequate consideration it deserved.

My experiences in the use of somnoform have been so pleasant and satisfactory to operator, patient and myself, that I trust you will find it worth your while to have me detail them at some length. If you are not already familiar with somnoform and are not using it routinely you are neglecting a very valuable anesthetic.

COMPOSITION.

In America, to avoid the criticism of a trade name and any misunderstanding regarding its newer composition, *somnoform* is now called *anesthetic mixture*, and I shall so refer to it throughout my paper. Anesthetic mixture, originated as somnoform by George Rolland, Dean of the Bordeaux Dental School, is an improved formula consisting of

Ethyl chlorid	83 per cent.
Methyl chlorid	16 per cent.
Ethyl bromid	1 per cent.

This mixture of highly volatile anesthetics is calculated to enter and leave the body with the same ease and rapidity as oxygen. By its extreme diffusibility the methyl chlorid secures promptness of anesthetic action in about the time it takes the red blood cells to travel from the lungs to the cerebral centers. The ethyl chlorid prolongs anesthesia while the slight amount of ethyl bromid produces a stage of analgesia, immediately following the anesthesia of nearly equal value for light operating. This stage of analgesia frequently exceeds in duration the period of anesthesia.

CLINICAL ADVANTAGES.

Anesthetic mixture has several clinical advantages over the use of ethyl chlorid alone:

1. Anesthesia is usually complete in from 15 to 50 seconds.
2. Excitement during induction or recovery, as a rule, is absent.
3. Muscular relaxation is more satisfactory and spasm of the masseters less frequent.
4. The incidence of respiratory and circulatory depression is not as often noted.
5. Headache, nausea, or vomiting are not as common.
6. It would seem safer so far as complications and risk of life are concerned.
7. Its administration is as easy as that of ethyl chlorid.
8. Anesthetic mixture causes no asphyxia, cyanosis or stertorous breathing, when properly given.
9. It may be used alone for analgesia or anesthesia of shorter or longer duration, or for inducing narcosis with other anesthetics.
10. It is equally serviceable in dental and surgical operations and its effects are so transient, that it is strictly an ambulant type of narcosis.

PHYSIOLOGICAL EFFECTS.

An anesthetic vapor approaching the specific gravity of oxygen and having a boiling point practically that of the temperature of the body, enters, dwells in and leaves the circulation and tissues with the least possible effects on metabolism and functions.

If the boiling point of the agent is lower (as with ether) the vapor will expand, oppose a greater pressure to the excretion of carbon dioxid and induce asphyxia or anoxemia, for the rate of giving off oxygen from hemoglobin is increased by a rise in the carbon dioxid pressure in the blood.

If the boiling point lies much above the temperature of the body, some of the vapor will be condensed and excreted air will contain less than the inhaled air (as with chloroform) and accumulation will result with consequent acapnia, and in such instances of lowered carbon dioxid content of the blood, due to over-ventilation or anoxemia, the hemoglobin clings to its oxygen and thus the tissues may be starved of it, although the hemoglobin in the vicinity holds much of it.

Thus, in the administration of anesthetic mixture, respiratory spasm usually arises from overdose or too concentrated vapor, or too closed method of use, thereby providing an excess of carbon dioxid; whereas respiratory depression follows overdose with lowered hemoglobin exchange and resulting acapnia.

*Read during the Joint Meeting of the Mid-Western Association of Anesthetists and the National Anesthesia Research Society, Hotel Muehlebach, Kansas City, October 24-26, 1921.

The rapidity of the action of anesthetic mixture is exemplified in the clinical fact that anesthesia deepens during some thirty seconds after withdrawal of the anesthetic.

EFFECTS ON THE BLOOD AND CIRCULATION.

Rolland, Muratet and Sabrazes, after investigating the blood plasma and blood cells following surgical anesthesia with anesthetic mixture, up to eighteen minutes duration, found no modification of any consequence or exceeding physiological limitations. Except in respiratory spasm or depression, the pulse rate and blood pressure remain practically at the individual's normal throughout administration. In the spasm type the systolic pressure always rises from 5 to 50 mm.; the diastolic varying. It may remain stationery, rise or fall in proportion to the systolic. Guedel, who has investigated this, has no explanation to offer, so far.

During depression of respiration the pulse rate is slowed, but remains of good quality and is regular. The systolic pressure rises and the diastolic rises or falls; pulse rate and pressure resume normal as soon as respiratory depression is relieved. (Guedel.)

EFFECTS ON THE NERVOUS SYSTEM.

Rolland and Cavalier have shown that the Purkinje cell is acted upon at the very beginning of anesthesia, while the pyramidal cell still remains intact. In this action of anesthetic mixture, an elective affinity for the cellular elements of the cerebellum is indicated. It is only after deep and prolonged anesthesia that the pyramidal cell is in turn affected. In acting on the Purkinje cells, anesthetic mixture suppresses sensibility to pain, then heat and cold during its passage through the cerebellum and when saturation occurs, anesthetic mixture reacts on the pyramidal cell, suppressing the sense of touch and producing loss of consciousness. This explanation of its effects on the nervous system, based on animal experiments, is in agreement with the reflex phenomena observed clinically during analgesia and its transition to anesthesia.

SIGNS AND SYMPTOMS OF THE THREE STAGES OF NARCOSIS.

Narcosis by means of anesthetic mixture may be divided into three stages:

(a) Analgesia.
(b) Light anesthesia.
(c) Deep anesthesia.

Analgesia: In this stgae the patient merely feels drowsy; the eyelids wink lazily and there is some tingling and numbness in the extremities. Patients can talk, are conscious of what is being done, but are insensible to the pain of light operating. They are able to assist the dental operator by moving the tongue and jaws or clearing the mouth. Analgesia is possible because the sense of pain is one of the first to succumb to the influence of anesthetic mixture.

In dentistry all operations, except the removal of live pulp and nerve extractions or handling of unusually hypersensitive dentine may be done under analgesia, without loss of consciousness.

Light anesthesia: This stage marks the transition from analgesia to the loss of consciousness. Its advent is marked by the onset of automatic or rhythmical breathing; some muscular relaxation; rolling of the eyeballs upward or oscillations from side to side; slight dilation of the pupil, without loss or corneal reflex. The limp arm is a good gauge of the muscular relaxation and onset of light anesthesia, which may occur within thirty seconds after beginning administration. Simple extractions in dentistry and brief minor or surgical procedures may be done under light anesthesia. In using anesthetic mixture for induction, it is at this time that the other anesthetic should be added and both continued until deep anesthesia supervenes.

Deep anesthesia: This degree of narcosis is shown by the eyeballs set in a fixed position; the abolition of the corneal reflex and dilated pupil. Rhythmical breathing becomes snoring on account of relaxation of the palatal muscles. Skeletal muscular relaxation is also usually present and sufficiently satisfactory for all operative purposes. Occasionally muscular spasm may occur and to avoid this complication, it is an advantage to insert a mouth gag or airway, during light anesthesia, when deep anesthesia of some duration is to follow.

In single dose administrations severer dental and surgical operations may be begun with the onset of deep anesthesia, with the expectation of the maximum period of anesthesia, of which anesthetic mixture is capable and a following period of operable analgesia.

For longer operations and multiple extractions, deeper anesthesia may be maintained by continuous administration, using the signs and symptoms of the eyeball, pupil, breathing, pulse, color and muscular relaxation as guides.

METHODS OF ADMINISTRATION.

The technic of administering anesthetic mixture depends on (1) the types of patients; or (2) sorts of operations; and whether (a) the single dose, (b) continuous open, (c) closed, or (d) nasal method is used.

(1) *Types of Patients*: In a general way, children, the aged, anemic and all hazardous risks should be given the single dose or continous anesthetic mixture by as open a method as possible, using oxygen if available. Plethoric patients and alcoholics may show some cyanosis during induction, but it is difficult to secure surgical narcosis with anesthetic mixture alone, except by the semi- or closed methods with some rebreathing. Hypertension and a rapid pulse require cautious induction, while patients with hypotension or even valvular lesions accept anesthesia with remarkable ease and comparative safety.

All patients should be given the safeguards of the breath-holding test and blood pressure readings before anesthesia.

Fear, neurasthenia and an extremely variable pulse rate frequently mean serious pathology underlying focal infection or endocrine exhaustion. Such patients are prone to develop acapina or to collapse under anesthesia and must be handled with due caution.

(2) *Sorts of Operations*: In dentistry or oral surgery, single dose administration suffices for simple extractions and even adenoid and tonsil operations for those who work with extreme rapidity. For slower operations and longer procedures, the nasal continuous administration is advisable. For superfical surgery either the continuous open or semi-closed method may be used, with sufficient air or oxygen admitted to avoid anoxemia or depression. The single dose may be used also to induce other anesthetics by the open or semi-closed methods.

Administration: In the open method a capsule of anesthetic mixture is sprayed on the gauze covering a Schimmelbusch or Yankauer mask, or onto the gauze in a semi-open ether device.

In the semi-closed or closed method the capsule is shattered in a special chamber and the vapor is admitted to a large rubber rebreathing bag, from which it reaches the patient through valves regulating the percentages of vapor and air admixture.

Nasal Administration: This is an especially valuable method and deserves detailed description, as it may be made to serve for all dental and for many surgical procedures of the specialties.

Using a DeFord or Stratford-Cookson device, the inhaler is adjusted to the patient's nose and head in a fixed position with the air valves open and the mouth piece raised. An ampoule of anesthetic mixture is fractured in the chamber, filling the bag with the vapor.

For operations under analgesia when the rubber dam is used, the mouth cover is not necessary. For tonsil, adenoid and other oral and longer dental operations under anesthesia, the intermittent use of the mouth cover is very helpful.

It is always advisable to introduce a mouth prop. When all is in readiness and the painless part of the operation has been completed, patients are allowed several breaths of air, then the regulating lever is slowly raised and the anesthetic vapor is admitted to the nasal inhaler in increasing volume with gradually decreasing admixture of air.

Analgesia: The vapor is admitted until the lazy winking of the eyelids indicates the onset of the obtunding effects of anesthetic mixture. Only several more breaths will be necessary for an analgesia of brief duration and it is not desirable for the patient to lose consciousness. When a plane of satisfactory analgesia has been secured the regulating lever may be pushed down to shut off the vapor, or may be intermittently manipulated to admit just the necessary amount of fresh vapor at each breath to make analgesia smooth and continuous. Patients may also decrease the effectiveness of analgesia by lighter or deeper breathing or by closing the lips at intervals, or by the use of the mouth cover. The continuous supply of anesthetic vapor is secured by fracturing fresh ampoules of anesthetic mixture in the chamber.

Anesthesia: To induce complete surgical anesthesia, the regulating valve is manipulated to admit vapor just rapidly enough not to elicit the nasal or oral reflexes of patients and rebreathing is not begun until automatic respiration has supervened and only then if deep narcosis is desired. Rebreathing is governed by partially closing the expiratory valve. Continuous anesthesia by nasal administration may be used for 15 to 20 minutes with entire satisfaction and is preferable to repeated single dose administrations. Proper packing, suction and control of bleeding materially assist in making continuous anesthesia satisfactory.

PREPARATION OF PATIENTS.

No patients should be given any anesthetic until their status as surgical and anesthetic risks have been definitely determined. Poor risks should be handled with every possible precaution and with every restorative measure at hand. Intoxicated persons should not be anesthetized. It is also advisable for patients to come to operation with the stomach empty. All tight clothing must be loosened and corsets removed before induction. Toilet facilities should be utilized.

The patient's psychic reactions and self-control may be largely determined by the attitude and influ-

ence of the anesthetist or operator. Patients should be advised about normal breathing for induction of surgical narcosis and about modified breathing for analgesia.

POSITION OF THE PATIENT.

Providing that free breathing is not interfered with, the patient may be placed in almost any position. My preference is the semi- or reclining one. At all times the patients must be protected from aspirating debris or swallowing blood; I know of no better emetic than swallowed blood.

AFTER-CARE OF PATIENTS.

The recovery of patients from analgesia is sometimes disconcerting to them on account of the rapid and confusing return of sensation; quiet, soothing reassurance will tide over any tendency to flightiness.

Nausea or vomiting may be induced by too rapid an attempt at recovery after brief operations and patients should be cautioned to remain lying back in the chair or on the table for some little time, until the effects of the anesthesia have entirely worn off. Vomiting may induce collapse in depressed patients and should be guarded against. Fasting, the use of the aspirator, accurate adjustment of dosage and proper oxygenation will go far in reducing the incidence of postanesthetic nausea and vomiting.

Acidosis, which may complicate infections and grave pathological conditions and which is a prime causative factor in postanesthetic vomiting, must be combated by preliminary carbohydrate feeding, the free use of alkalies and Fisher's solution. Fruit juices, alkalies and glucose should also be used postoperatively.

MEETING EMERGENCIES.

Laboratory research and clinical observations have determined that spasm (anoxemic) and respiratory depression (acapnial) are the emergencies that arise and must be combated. Fortunately the circulation and heart are affected later than respiration and respiration is usually restored automatically by withdrawal of the anesthetic. Precordial or chest manipulation, artifical respiration or rhythmical tongue traction should be used if needed. In depression 1-100 grain of nitroglycerin may be dissolved under the tongue; amyl nitrite or aromatic spirits of ammonia held to the nose; 8 to 10 drops of adrenalin chlorid solution may be dropped into the conjunctival sac or an intramuscular injection of pituitrin may be given. The horizontal or preferably a slight Trendelenberg posture should be used in combating collapse.

117 WEST PITKIN ST.

PROPERLY GIVEN, IS CHLOROFORM THE DANGEROUS ANESTHETIC REPRESENTED?*

RALPH P. BEEBE, M.D.
KALAMAZOO, MICH.

About 76 years ago, nearly synchronously, the leading anesthetic agents, chloroform, ether and nitrous oxid, were successfully introduced. They are increasingly in use today. As to other anesthetic agents there has been but little, if any, scientific progress.

For some fifty years the controversy as to the merits of chloroform and ether was carried on by the partisans of each, at times very strenuously. But out of the controversy there were established certain rules to guide in inducing anesthesia, as well as certain precautions against the dangers to be avoided. These principles still hold good today.

For the past ten years chloroform has had but few advocates. All its demerits and dangers have been kept before physicians and surgeons until now their state of mind is such that the mention of chloroform sends a tremor down their backs. In favoring chloroform, I trust you will not be shocked at my temerity.

DANGERS OF ANESTHETICS.

The degree of danger attending the use of various anesthetics is still unknown. The more postoperative fatalities are studied the more evident it becomes that a considerable proportion of the mortality is indirectly due to the effects of the anesthetic. But chloroform is not the only anesthetic agent that has a mortality. In using the newer anesthetic agents more widely, anesthetists are reporting deaths as in the earlier days of anesthesia by chloroform and ether.

I have anesthetized 1,571 cases with chloroform, and I shall divide them into three groups (according to different conditions). The records of the first two groups are not complete.

STATISTICAL DATA.

The first 300 chloroform anesthesias were administered years ago in lumber camps and agricultural communities. The clientele were robust and good subjects for anesthesia, and the operations were mainly and mostly for accidental injuries, without any complications. But when I consider the crudeness of the method used in administering chloroform, and the number administered by laymen, I would not have been surprised if there had been complications.

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921.

There were 500 chloroform anesthesia from 1893 to 1906. About one-half were given in hospitals, the other half in private residences, with no complications. Also 771 cases were recorded from 1906 to the present time, with no fatalities. These anesthesias were nearly all given in the hospital.

There were three cases of *partial cardiac failure;* two soon after operation commenced, requiring artificial respiration and stimulants; the third case, the most serious, was at a private residence. The operation was for anal fissure and hemorrhoids and was performed by Dr. Rush McNair. The operation was completed and the anesthetic discontinued. The patient was breathing quietly. She had a good color and pulse. The pupils were slightly contracted; in fact she seemed to be coming out of anesthesia. Suddenly she passed into the following condition: The head was slightly turned to one side; the face was deadly pale; eyes were slightly open; pupils were widely dilated, immobile, and the pulse and respiration almost extinct. The head was lowered; artificial respiration and tongue traction were performed until pulse and respiration were restored. I mention the case to show the necessity of carefully watching the patient even after operation is completed. With the exception of these three cases, the 1,571 in all respects were very good.

POINTERS IN TECHNIC.

We all know that chloroform is subtle and quick in action and eternal vigilance is the price of safety. But the same vigilance should be exercised with every anesthetic agent. However, complications can nearly all be avoided by careful administration of chloroform.

In the *induction stage,* the administration of chloroform should not only be *continuous* but should also be *progressive.* The strength of vapor should be increased as rapidly as is possible without distressing the patient, for it is well to bring the patient under the full influence of chloroform as quickly as is practicable.

To successfully anesthetize is to keep the patient entirely undisturbed while at all conscious. Do not be hurried by the surgeon who wants to save time. Keep the patient fully anesthetized and make the administration continuous. This applies to ether as well as chloroform. *The intermittent administration of an anesthetic is harmful.* It necessitates a prolonged induction period and the expenditure of a larger amount of the anesthetic. You cannot have a smooth anesthesia unless the administration of the anesthetic is continuous.

Henderson has called attention to the dangers attending the intermittent administration of anesthetic agents. He concludes that in prolonged light anesthesia consequent excitement and especially in any intermittent method of administering ether or chloroform, peculiar dangers are involved. The bad effects may be immediate or postoperative.

The earlier stages of the operation should be performed under a full degree of anesthesia. The strength of the vapor may be diminished as the operation proceeds, for then a less amount suffices to maintain a sufficient depth of narcosis. Narcosis should be properly maintained up to the last stages of the operation.

Full and continuous anesthesia was insisted on by Dr. Syme of Edinburgh, and practiced with undoubted success. There is no doubt that under Syme's instruction his patients were fully anesthetized, and according to record he never had a death from the effects of chloroform.

ABNORMAL SUSCEPTIBILITY.

The susceptibility of patients to chloroform is a matter of great importance, and has not received the attention it deserves. As to the cause of dangerous symptoms and even disaster, it is mentioned by Bilroth, Roberts, Gross and Hewitt and others, that patients may display marked susceptibility to chloroform and may thus exhibit serious symptoms from doses which, in a majority of cases, would have no such deleterious effect.

This is in accordance with my own experience. One is often surprised by the very large or very small quantity of chloroform, as the case may be which different patients require. Variations in susceptibility will be found in all classes of patients; alcoholic, neurotic, plethoric and anemic; and for this reason the administrator must be on guard when dealing with an extremely susceptible patient. He may very easily overstep the boundaries of safety, and for that reason the anesthetist must watch his patient very closely during early chloroformization. One cannot tell which patient is susceptible to chloroform until the time of administration. The anesthetist must keep a close survey of his patient and watch the effect of every drop of chloroform. If he does this, he will avoid trouble and disaster.

It is my opinion this abnormal susceptibility to chloroform is the cause of complications and fatalities in the early stages of chloroform anesthesia, and the greater number of these can be avoided by watchfulness and care.

We have read and heard much about *over-dosage,* a term I do not like. I think *over-supplying* would be more appropriate, but as the term has been long

in use, I will continue to use it, but it applies to ether as well as chloroform.

Over-dosage is not necessarily immediately fatal, but is apt to cause fatal postoperative complications. Often I have seen patients removed from the operating room and placed in bed fairly reeking with the fumes of the anesthetic. The patient bathed in perspiration, cyanosed, and remaining semi-conscious from 12 to 48 hours. What is the picture we have before us? All the symptoms and signs of profound anesthetic shock—a condition certainly not conducive to the well being of the patient. It is a condition that lowers the vitality of the patient, who is made more susceptible to the effect of toxemia of all kinds on account of the stagnation of blood in the capillaries and veins. We learn from laboratory research work that over-dosage and prolonged anesthesia deteriorate the blood and strongly militates against recovery. Over-dosage lessens tissue resistance and leads to sepsis; also weakens the blood clots, which easily break down and lead to secondary hemorrhage. This deteriorated condition of the blood is at its height from the sixth to tenth day, at the very time these serious complications take place. This may be a coincidence, but I believe it is the result of over-dosage. The anesthetic is not at fault, but the anesthetist.

IDEAL ANESTHESIA.

The abuse of ether as to over-dozage is also great. How often we hear the remark: "If the anesthetist lacks experience, why he can give ether." This statement has sometimes been authoritatively printed.

Skeel concluded that ether is safe as far as primary mortality is concerned, in the hands of a fairly competent anesthetist, if the anesthesia is not so prolonged as to cause ether poisoning.

It requires skill and practice to induce a smooth ether anesthesia which is so necessary to aid the surgeon and for the future well being of the patient.

The opinion that a very deep anesthesia is beneficial is a fallacy; it is to be avoided, because it promotes stagnation of the blood in the capillaries and veins, which leads to other serious complications. The ideal depth of anesthesia is that in which the troublesome reflexes of vomiting and struggling are abolished, and in which the tone of the muscles are well preserved.

There is no anesthetic agent, either general or local, which is free from danger when ignorantly or carelessly employed. Most complications and disasters could be avoided if greater attention were given to the subject of anesthesia. The ideal anesthetic agent which is suitable for all cases has not been discovered. There are many patients who exhibit decided idiosyncrasies, and for these we must choose the proper anesthetic agent. Chloroform has its advantages, also its disadvantages, but in properly selected cases it has proved very satisfactory, and for this reason it should be used more often. No one anesthetic agent can possibly be universally adopted if the best results are to be obtained. If once the anesthetist grasps the fact that every case of anesthesia is a study in itself, in the selection of the appropriate agent for safety and the operator's convenience, fully appreciating that every case has its risks and after dangers, he will continue to improve as years advance.

It has been said that familiarity breeds contempt. The anesthetist must never forget to approach each case with a certain degree of fear and respect, for the possibilities of success as well as disaster in each are almost unlimited.

BANK BLDG.

SOME NEW ANESTHETIC ETHERS.*

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During the past three years two modifications of anesthetic ether, as it was known previously, have been introduced. One by Cotton[1] of Toronto, which goes by the name of *Cotton Process Ether,* and the other by Wallis and Hewer[2], of St. Bartholomew's Hospital, London, known as *Ethanesal.* These newer anesthetics have come into existence as a result of attempts on the part of their authors to eliminate totally, or at least in part, the discomfort of induction, the disagreeable after-effects, as well as the dangers of administration of ether.

Ethyl ether, as prepared for anesthetic purposes, contains small quantities of impurities, the chief of which are alcohol, water, acetone, mercaptans and thio-ethers. Those formed by oxidation on standing comprise aldehydes, peroxides and acids.

Some years ago Cotton was led to attempt the removal of all these impurities and finally succeeded in obtaining an absolutely pure ether. He found to his surprise that this pure ether failed to anesthetize, even when given in very large doses and for a considerable period of time. He, therefore, tried adding certain of the ingredients previously removed and finally evolved the mixture now known as *Cotton Process Ether,* which, according to the manufacturers, consists of "Highly refined diethyl oxid, plus approximately two volumes of ethylene, one-half

*Read before the Manitoba Hospital Association and Society of Chemists Meetings, Winnipeg, 1922.

volume of carbon dioxid and 1 per cent by weight of ethyl alcohol."

The claim is made that less of this ether is required; that postoperative vomiting is markedly reduced; that the induction time is shortened, and that an *analgesia* can be produced, which permits of major operative procedures being conducted with a very light degree of narcosis, sometimes with the patient only in the *first stage*.

The following is one of such cases reported by Dr. Cotton:—

"*Case* 3.—Open mask administration direct from container. Male; aged 18; weight 180 lbs.; operation: adhesions and resection of tubercular mass from abdomen. Time of operation, 1 hour and 10 minutes. Patient remained very clear mentally and cracked jokes throughout. He was given a small meal while the surgeons were operating on him. Abdomen was completely relaxed. Eyes were slightly dilated and pulse remained at 80. Amount of ether used, 3 ounces."

EXPERIENCES WITH COTTON PROCESS ETHER.

The *Cotton Process Ether,* used at the Winnipeg General Hospital, was manufactured by the Dupont Chemical Co., and was supplied in one-quarter pound tins. When poured into a bottle bubbles of carbon dioxid gas could be seen rising, very much as from a good brand of champagne. The administrations were mostly by the so-called open method on a mask covered by 15 to 20 layers of gauze (depending on the weight of the gauze). By this method I found, to my great disappointment, that the induction period was, on the average, longer than with other ethers. Often 16 to 18 minutes after commencing induction the patient only reached the second stage of anesthesia. The excitement period was considerably prolonged, and the quantity of anesthetic was greater than with the make in ordinary use in this institution.

Given in this manner it is reasonable to suppose that most of the carbon dioxid escapes and that very little is inspired by the patient. Therefore, some administrations were made by the closed method, in which, as with other ethers, a far smaller quantity sufficed. It was also used in a Stock's inhaler, where the anesthetic is vaporized by the passage of air through the liquid, and also administered with oxygen and nitrous oxid and oxygen.

In a very few cases the operations were conducted with the patient in the second stage of anesthesia. This, however, can be accomplished with other ethers about as often. Postoperative vomiting, and also the time of regaining consciousness was about the same as with the ordinary anesthetic ethers.

EXPERIENCES WITH ETHANESAL.

Ethanesal is the name given to the new ether recently produced by Wallis and Hewer. Wallis had unusual opportunities, some years ago when in India—where the climate causes rapid deterioration of ether—of testing many samples, and devising means of purifying them. The mercaptans were found to be the chief impurity; and were found to cause salivation, lacrymation and severe headache. He carried on his experiments until he obtained a pure ether which he found, as had Cotton, only produced a state of excitement on inhalation, with no true anesthesia.

He then tried the addition of ethylene, as in Cotton's ether, but found it unsatisfactory and finally added the ketones to the extent of 2 per cent. Stronger solutions being found inadvisable.

The advantages claimed for ethanesal are:

1. It is less toxic than chloroform or ether, and the safety margin is greater than with ether.
2. It is less irritating to the respiratory passages than ether.
3. Postanesthetic vomiting is less than with chloroform or ether.
4. The taste and smell noticed afterwards by the patient are much less than with ether, and are generally absent.
5. The pulse pressure is higher than with either ether or chloroform.

Ethanesal has been used as the anesthetic in a number of operations at the Winnipeg General Hospital. The odor is less pungent and more fruity than that of ether, and, therefore, not so irritating to the mucous membrane of the respiratory passages. The breathing is quieter, a light stertor being present, though much less obvious than that of ether. The after-taste is less persistent and less unpleasant, and salivation is also less than after ether.

The stages of anesthesia are the same as with ether but a little shorter. If the operation is extra-abdominal and prolonged, the anesthesia may—after it has proceeded for some time—be allowed to become very light, the patient, though in some cases blinking his eyes, will remain motionless and apparently without pain.

The pulse rate is less than under ether, in the majority of instances between 80 and 100. The blood pressure is not lowered to the same extent as with ether.

Muscular relaxation is greater, the abdominal muscles in laparotomies relaxing to a degree approximating that produced by chloroform rather than that of ether. The quieter respiration causes less abdominal movement. I have succeeded in obtaining a satisfactory relaxation of these muscles for a surgeon, in whose cases I invariably am obliged to have recourse to a certain amount of chloroform, when

anesthetizing with ether for intra-abdominal operations, in order to produce the desired relaxation.

CONCLUSIONS.

One requires a little practice to get used to this anesthetic. The tendency being to keep the patient more deeply under than is necessary. The corneal reflex may be allowed to be fairly brisk in many cases, the abdominal muscles being quite relaxed. If not kept under too deeply patients wake up more rapidly than after ether.

The quantity of anesthetic required is about two-thirds that of ether. Vomiting is somewhat lessened, unless the anesthetic has been pushed to an unnecessary depth. This, in part, may be owing to the rather pleasant odor, the less disagreeable taste left in the mouth after its use, and the lessened salivation.

The age of the patients has varied from 3 months to 70 years. The duration of anesthesia from 10 minutes to 115 minutes.

The researches performed by these workers appear to be of the utmost importance. As yet one cannot expect efforts in removing the disagreeable and dangerous ingredients contained in anesthetic liquids to be final. Instead, I think we may look forward in the confident belief that we are only at the beginning of an era of chemical research into all anesthetic substances. The good already accomplished will certainly stimulate those who have so assiduously labored to lessen the discomforts and dangers, and thereby the fear of anesthesia; and will doubtless cause others, who have the necessary chemical knowledge, to persevere in the effort to ultimately provide the perfect anesthetic.

167 MAYFAIR AVE.

REFERENCES.

1. Amer. Jour. of Surg., Anesthesia Supplement, April, 1919.
2. Lancet, June 4, 1921, p. 1173.

Make your plans now to attend the Joint Meeting of the Interstate Association of Anesthetists and the National Anesthesia Research Society, at the Hotel Deshler, Columbus, Ohio, October 30 to November 1. Primarily this meeting will be a conference on the Teaching of Anesthesia and Bettering of Hospital Anesthetic Service. Special sessions will also be devoted to Anesthesia for Oral Surgery and Dentistry as well as to Current Researches and Newer Practices in Anesthesia. Make your hotel reservations at once and also notify the Editor if you wish to present a paper, giving the title and brief abstract so that it can be properly placed on the program.

EXPERIMENTAL AND CLINICAL OBSERVATIONS ON COTTON PROCESS ETHER.*

PAUL CASSIDY, D.D.S.
CINCINNATI, OHIO.

Cotton Process Ether is a physical mixture of pure sulphuric ether, carbon dioxid and ethylene, compressed for convenience sake as well as for economy, into liquid form. The difference in diffusibility of the gases it contains is such that, upon the opening of the package to pour the liquid into an anesthetizer or to use by drip upon the usual open cone, a great deal of the gas of highest volatility is dissipated into the atmosphere and the value of the original mixture lessened in just that degree.

LOSS OF ETHYLENE ON EXPOSURE.

Having had but indifferent success in the use of Cotton Process Ether in open work and even in fairly well closed apparatus, such as the Ben Morgan, Heidbrink and McKesson, I have tried to devise a machine by which I could deliver to the patient the exact mixture as originally compounded. *To do this it is necessary that the package containing the ether be opened within the anesthetizer itself.* To indicate just how necessary this procedure is I have had exact tests made to determine every five minutes over a period of one hour the exact loss of the highly diffusible ethylene. The results of these tests are as follows:

Time	Temperature	Ethylene
1.05	79.7°	2.24
1.10	79.7°	1.87
1.15	79.7°	1.32
1.20	79.7°	1.12
1.25	79.7°	.72
1.30	81.5°	.31
1.35	81.5°	.30
1.40	81.5°	.26
1.45	81.5°	.24
1.50	81.5°	.24
1.55	81.5°	.24
2.00	81.5°	.24
2.05	81.5°	.24

You will note that the ethylene shows a very rapid loss during the first twenty minutes. As I had anticipated, the loss in the first few minutes changes the mixture greatly. While the ethylene content, which remained constant during the last twenty-five minutes of the hour, represents a higher percentage than is present in the average anesthesia ether when the container is first opened, the original mixture loses

*Read by proxy during the Joint Meeting of the Canadian, Interstate and New York Anesthetists with the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921.

its value as an improved anesthetic if we accept the loss which is sustained as without bearing on that value.

DEVELOPMENT OF AN ANESTHETIZER FOR COTTON PROCESS ETHER.

As I have said, to prevent this loss which I have assumed occurs, it was necessary to construct an anesthetizer which would permit the opening of the package containing the ether to be made within the anesthetizer itself.

With the glass containers, used in the experimental work of J. H. Cotton, this was easy to accomplish. When it became necessary to open a can of tin, however, considerable difficulty was experienced before I could claim any success. This was finally arrived at by constructing a copper bag of three gallons capacity which would withstand a pressure of fifty pounds. To this was solidly attached another copper can, slightly larger in all dimensions than the can the Cotton Process Ether is delivered in. At the base of the smaller receptacle was firmly fastened a spear of Mondel metal. The top of the copper can was threaded to accommodate a threaded lid. By placing the ether package inverted upon the spear and screwing the cap of the copper can into position, the spear was made to penetrate the tin after the cap was fairly well seated and only an inconsiderable, if any, loss of ethylene occurred. Mondel metal was finally used as it was found that very rapid disintegration of steel occurs in its use in this connection. The Mondel metal is impermeable to the action of ether.

After having found that it was practical to open the cans and pour out the contents without any loss and to retain those contents within the anesthetizer for a considerable time without loss, it was discovered that the same difference in diffusibility of the gases permitted the more highly volatile ethylene to emerge first upon opening the exit valve.

As the value of Cotton Process Ether, if any greater than that of average ether, can only be ascribed to the mixture it is made up of, it was necessary that some method of agitation be devised, by which, throughout all anesthesias, every inspiration would be made up of the mixture itself and not varying parts thereof.

Purely mechanical means of agitation can be utilized, but are tiresome and the apparatus is cumbersome to shake around for even a few minutes. Having for many years been an advocate of warmed vapor anesthesias I turned to the heating method and, after some failures, it was proven a successful means to the end desired. Care must be taken, of course, in heating any ether; as this mixture has an indicated flash-point 110° Fahrenheit, it is necessary to observe a special caution in the devising and the use of any anesthetizer to be heated for its employment.

As the chamber of the anesthetizer I have made and suggested for use is constructed of heavy copper, it can be immersed in a hot water bath of any degree of temperature desired. If the cool water is changed for warm from time to time during a prolonged anesthesia, the agitation within the copper chamber, produced by the heat, continues and very satisfactory results can be obtained. To maintain any given temperature and consequent even agitation and flow of the gases with a water bath, requires an apparatus that is more cumbersome, in consequence less portable, that where direct heat is obtained by means of an electric light bulb placed within the copper chamber itself. Of course, it is necessary to insert the bulb into a chamber within the copper receptacle and the two hermetically sealed one from the other. Were this not accomplished, disastrous results might follow and leakage of the gaseous contents would occur, in any event. By placing a cut-off, of some form, within easy reach of the operator and selecting an electric bulb of the proper type and size, a very even temperature is easily maintained during extended anesthesia. It is necessary to turn the electric current off and on from time to time, but a very little watchfulness over a mercury thermometer attached makes this a simple matter. These thermometers can be cheaply obtained from the manufacturers who will thread down the connections to any size desired.

I always use Cotton Process Ether in this anesthetizer in connection with oxygen and either rebreathe or attach a carbon dioxid cylinder as well.

ADVANTAGES.

I will not include any case reports in this paper to take up your time, but I do want to say that we have noted a startling difference in consequent nauseas. Apparently from the little we have been able to study the facts, this mixture, so given, is a better anesthetic for all operations on the kidneys and the urinary tract than straight ether, no matter how given. This may be in consequence of the necessity for saturation in the use of the latter and the lack of necessity for saturation in the employment of the former. A lighter narcosis is possible in any operation with Cotton Process Ether given after this fashion than can be maintained with ether and more nearly approaches a nitrous oxid-oxygen-carbon dioxid anesthesia than any other agent or method does or can. A one-quarter pound can will maintain

perfect anesthesia for two hours during the most serious operation and this, in consequence, means very little waste, saturation of the patient, and a more rapid complete return to consciousness, with little, if any, anesthesia consequences. I might add that recovery is equally as rapid as follows nitrous oxid-oxygen anesthesia.

I have made no attempt to present these simple facts in a scientific fashion, but I have endeavored to reawaken an interest in a product which has been very badly marketed; which never has gained the place it merits in the affection of members of the allied profession and which, with the various anesthetizers now on the market and popularly used, cannot be employed to the best advantage.

I have told you how we have succeeded in using Cotton Process Ether in an anesthetizer you all can have made for yourselves and I hope I have succeeded in indicating at least the merits of warming the gas to produce an even flow of the entire mixture as originally compounded, which is after all, the only excuse for its being utilized.

The Livingston-Seventh and Race Sts.

THE SCOPE AND UTILITY OF PRESSURE NITROUS OXID-OXYGEN ANESTHESIA.*

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In previous papers I have called attention to certain functions which may be performed by the administration of nitrous oxid-oxygen under *positive pressure*. In the present discussion I want to bring forward in more detail these and other observations which have been made in a clinical study of the subject.

Nitrous oxid has been administered under positive pressure for many years. While prevention of air dilution, through an open air passage which is the site of an operation, has usually been the function of positive pressure in the past, and was considered the most important function for positive pressure, the idea was also advanced that through positive pressure a larger absorption of the anesthetic gases is secured. But when it is remembered that a maintained positive pressure of not more than 5 mm. of Hg. is permissible during an anesthetic, it is doubtful if a difference in depth of anesthesia is really appreciable. In view of the imperfect construction of older anesthetic appliances, I believe that the deeper narcosis secured, when administering the gases under positive pressure, was due not so much to an increased absorption of the gases, as to the elimination of air leaks into the appliance during inhalation. The leakage in this instance would be outward, preventing the ingress of air. Even at the present time, when appliances are being more perfectly constructed, failure to secure perfect nitrous oxid-oxygen anesthesia *without ether* is often due to leakage between the face and the inhaler when imperfectly applied. Most of us are aware of the fact that a pin hole admits air in sufficient quantities to prevent proper narcosis while negative pressure develops during inspiration. The proportion of nitrous oxid and oxygen in the mixture undoubtedly determines the plane of narcosis, whether the anesthetic mixture is administered under positive or under negative pressure, *providing abnormal respiratory and circulatory conditions are excluded.*

Physiological Variations.

Referring to the physiology of respiration, we find that the intra-pleural pressure is minus 10 mm. of Hg. on inhalation, and minus only 5 mm. on exhalation—so there is a negative pressure in the pleural cavity at all times under physiological conditions. The intra-pulmonary pressure upon inhalation is normally 2 to 3 mm. of Hg. negative pressure; but upon exhalation, 2 to 4 mm. positive pressure. The average tidal respiration during anesthesia is between 400 and 500 cc., although in many cases there are wide variations from this normal which influence the total amount of gases inhaled per minute. The normal quantity of air inhaled is between 7 and 9 liters per minute, which is the ventilation. Under anesthesia, however, the ventilation varies from subnormal to even three times the normal, but in most instances is above normal, which is commonly due to the rate of respiration having been increased.

In its relation to the circulation the thorax is a large pump with a very important function, *namely* that of assisting in the movement of the blood. It is very doubtful if this function is sufficiently appreciated by anesthetists in general. At any rate the patency of the air-way is not sufficiently guarded. During inhalation, when the negative pressure develops within the lungs and air passages, the great veins in the thorax are filled with blood from the balance of the body. With the increased flow of blood into the right heart, the heart rate is increased carrying the blood through the lungs, distending the capillaries about the air vesicles. At first the blood pressure falls, but toward the end and during the first part of exhalation the arterial pressure increases. In the latter half of exhalation the blood

*President's Address presented before the Joint Meeting of the National Anesthesia Research Society with the Mid-Western Association of Anesthetists, Hotel Muehlebach, Kansas City, October 24-26, 1921.

pressure again falls, due to the damming back of the blood entering the lungs, and the smaller quantity entering the left auricle. This respiratory variation of blood pressure normally amounts to from 5 to 8 mm. Hg. While the patient exhales the heart rate becomes slower, and upon inhalation is more rapid.

Abnormal Fluctuations.

Under abnormal conditions, such as are frequently encountered during surgical operations, the fluctuation of blood pressure and pulse rate during respiration is greatly magnified. I have seen patients in whom blood pressure varied as much as 30 mm. of Hg. between inhalations and exhalations. In each instance it was due to some obstruction in the air passage from a faulty position of the head, misplaced tongue, some tumor or growth impinging upon the trachea, or a valve like action of the ali nasi.

The effects produced by an obstruction of an air passage depends upon whether the obstruction occurs during inhalation or exhalation, or whether both inhalations and exhalations are equally obstructed. When the inhalation is more obstructed than exhalation the blood pressures have a tendency to fall, while the pulse rate usually increases. The pulse pressure is particularly affected. When both inhalations and exhalations are equally obstructed the effects are similar. On the other hand, when the exhalation is more obstructed than the inhalation, the systolic and diastolic blood pressures may fall, if the obstruction is serious enough to markedly interfere with the ventilation. The pulse pressure, however, is relatively increased, that is, the pulse pressure-diastolic ratio, which is normally as one is to two, may be increased until the ratio is as much as one is to one. Under the same conditions there is a noticeable congestion of the large veins in the head and neck, and there may be cyanosis in the presence of sufficient oxygen to ordinarily oxygenate the blood. The congestion is probably due to the damming of blood away from the thorax.

No doubt the general effect of respiratory obstruction upon the pulse and blood pressure is, in part, due to its effect upon the ventilation of the blood. The tidal volume is usually decreased in respiratory obstruction even when slight. When the obstruction is largely inspiratory the rate of respiration is usually increased. On the other hand, when it is largely expiratory the rate of respiration is often decreased as compared with the respiratory rate with free air passages. If the labor of respiration is sufficient to effect adequate ventilation under obstructive conditions, deep anesthesia may be secured, but where the ventilation is reduced, so that the minute volume is less than 7000 c.c., deep surgical narcosis is not usually obtained unless the patient has previously received a fair dose of morphin, or ether has been added to the nitrous oxid-oxygen. Any obstruction of the air passages, of course, increases the labor of the patient, and if allowed to continue over a long period, contributes to his general exhaustion.

It is, of course, obvious to even those who have not considered these facts, that the position of the head, tongue, and chest should be such as to secure free, easy respiration, and if necessary an artificial air-way should be employed.

If an obstruction is of such a nature that an artificial air-way will *not* correct it, it will be found that by the administration of gases under pressure, the difficulty may be corrected.

Utilization of Pressure Changes.

There are a number of conditions encountered in which it is advantageous and desirable to alter the intra-pulmonary pressure within certain limits. We may administer the gases in such a way that the patient must draw somewhat harder than usual, and thus increase the negative intra-pulmonary pressure. On the other hand, the gases may be administered under sufficient pressure that no negative intra-pulmonary pressure develops. In other words, the gases may be literally forced into the lungs. Upon exhalation one may so set the expiratory valve that exhalations are easy and free, or adjust it so as to increase the intra-pulmonary pressure upon exhalation.

It has been found that by administering gases under an inspiratory pressure of 3 mm. of Hg. and 8 mm. expiratory pressure, both pulse and respiration are slowed, and the blood pressure falls slightly.

In the application of pressures for their effect upon the patient, the apparatus must be so arranged as to be adjustable in the production of negative or positive inspiratory and expiratory pressures. At the same time it is essential that we have the use of rebreathing in some instances to stimulate the depth of respiration for its beneficial action, not only on anesthesia, through the increased exposure and absorption of the gases, but also on circulation by stimulating the thoracic pump action.

There are but few conditions in which I have found it desirable to increase the *negative pressure* upon inhalation. When the pulse pressure is falling and the diastolic pressure is relatively low—as is sometimes seen in beginning shock—a slight increase of negative inspiratory pressure often benefits the patient by increasing the pulse pressure and

the movement of blood. The air passage, of course, must be perfectly free under such circumstances. At the same time, I have also found *slight positive pressure* upon exhalation an aid in propelling the blood by further augmenting the pulse pressure. This manipulation of the circulation by means of increasing the negative inspiratory and the positive expiratory pressures has been of no avail to my knowledge where surgical shock has been well developed, and therefore, does not rank with intravenous salt solution as a remedial measure.

Occasionally patients are encountered whose respirations become very rapid from some cause or other and whose pulse also is increased and whom the respirations of themselves would lead to exhaustion in the course of a prolonged operation. In such cases I have found it feasible sometimes to increase the expiratory pressure by tightening the exhaling valve sufficiently to produce positive pressure of 6 to 7 mm., thereby usually slowing the respiration. Such a procedure is not often feasible where the abdomen is open, since much additional expiratory effort may crowd the intestines into the incision. In other operations, and especially dental surgery, such a procedure may be very readily carried out, if the mouth is thoroughly packed with gauze to prevent the escape of gases during exhalations.

Oxygen Under Pressure in Bronchorrhea.

Several years ago, during the course of a goiter operation in which there was some difficulty on inhalation, I had a patient develop bronchorrhea, for which I could give no satisfactory explanation. On account of the inefficient ventilation and cyanosis which developed from the bronchorrhea together with labored respirations, I administered oxygen under heavy positive pressure for a few moments when the condition improved. The patient made an uneventful recovery. Since that time I have not seen a similar condition under nitrous oxid-oxygen anesthesia, but on February 21, 1920, I was called to administer oxygen to Mr. C—, a patient apparently dying of acute cardiac incompetency with extreme pulmonary edema, and froth almost filling the lungs. The dyspnea, which had been extreme, was failing with a low ventilation, ashy color and widely dilated pupils. The patient was unconscious at the moment oxygen administrations were begun. The carotid pulse was weak, the radial pulse imperceptible. The rate was very rapid and of an irregular rhythm.

My first thought was to clear the lungs of froth so the oxygen could be administered to the heart muscle. How could the bubbles of the froth be ruptured? Upon placing the inhaler over the patient's face I immediately discovered that his tidal respiration was less than 200 cc.! I, therefore, performed artificial respiration by inflating the lungs under considerable pressure at the moment when the patient was attempting to exhale, then jerking the inhaler from the face when the inspiratory effort was begun. In other words, I was utilizing his expiratory pressure and adding to it a positive pressure from the machine. By this maneuver I hoped to compress the bubbles and by the sudden release of pressure to distend and rupture them. Within five minutes the patient was conscious, the ashy hue had changed to pink, and the patient began to cough up a considerable quantity of a clear straw colored fluid, the pupils contracted and the patient was in very much improved condition. From this moment the patient was able to co-operate and further increase his expiratory effort while I was inflating his lungs. Within ten to fifteen minutes the pulse was perceptible at the wrist and the rattle in the lungs had disappeared. By means of the normal inspiratory negative pressure and the very high expiratory positive pressure thus induced, the circulation was materially improved and much labor probably taken from the heart. I believe an opportunity for retraction of the heart muscle was afforded. A few weeks later, however, during a similar attack the patient died before relief could reach him.

I agree with Evarts A. Graham's theory, that pleural exudates have been caused, at least in part, by excessive negative intra-pleural pressure, in which there is edema of the lungs or other diseases interfering with their proper expansion, but in addition to his view I believe that by rapid respiration in cardiac insufficiency, pulmonary edema is intensified and that by permitting an increase of the inspiratory negative pressure during an anesthetic with such conditions, bronchorrhea may develop. It is doubtful if the irritating fumes of ether may be blamed for all the cases of bronchorrhea which occur during its administration. I am firmly of the opinion that an inspiratory obstruction is responsible for a large number of cases, some of which might be relieved by a proper position, drainage, or the introduction of an artificial air-way.

Pressure in Infants, Pneumo-Thorax and Empyema.

During the first few inhalations of induction I commonly administer the gases under a very *slight pressure,* about one mm. of Hg. This I do for its psychological effect upon the patient, but when consciousness is lost and when there is no indication for the use of positive pressure, I always adjust the apparatus so that no effort is required to draw

the gas, but still no pressure is produced in the inhaler during inhalations. On exhalations I prefer a slightly increased pressure over normal by setting the exhaling valve at a very light tension, about one mm. of Hg. In infants of a few weeks, in whom the thorax is always poorly developed, and in whom the air passages may be more or less blocked with mucus, care should be taken not to increase the negative inspiratory pressure, nor increase the expiratory positive pressure. It is rather preferable to have a very slight positive pressure in the mask with infants.

In certain operations, in the kidney region or upon the chest wall, the pleural cavity may be opened by accident. If the patient is in the lithotomy position lying on the left side, the right lung collapses because of the sucking wound or pneumo-thorax. The death of the patient may take place within a few seconds due to the inability to breathe. Here is a condition in which positive intra-pulmonary pressure during inspiration should be maintained until the wound is closed. The pressure required depends upon and is regulated by the inflation of the lung until it fills the pleural cavity. At the same time the exhaling valve must be so adjusted that it maintains this pressure, but that it will permit exhalations.

After the resection of one or more ribs for empyema, inspiratory pressure should be gradually increased as the chest is evacuated of pus. On account of the usual toxemia in these cases a larger percentage of oxygen at this time should be administered, although the patient has been previously *carried* on a higher percentage than normal. In most instances when the pus has been quite completely evacuated, large masses of exudate are now forced into the opening, and with a little assistance they may be removed, shortening the period of convalescence, which these masses, sometimes as large as the hand, would necessitate.

PRESSURE IN ORAL, NASAL AND SINUS SURGERY.

In conslusion I want to say a few words regarding the use of pressure in oral, nasal and sinus surgery. While pressure in this field is more understood generally, there is still some misunderstanding regarding the *amount of pressure* to be used and its purpose. As already mentioned, when the oral or the nasal passages are exposed for operation, it is usually difficult to produce a positive intra-pulmonary pressure during inhalation, unless there is some growth or other obstruction in the operative field. Nevertheless, considerable pressure is required in the mask to prevent inhalation of air through the open air passages. Since the perfect exclusion of all air dilution from the lungs is the first essential to deep narcosis, success or failure of the anesthesia depends upon the pressure under which the gases are administered. The necessary pressure must be maintained whether rapid or slow or deep inhalations are taken. In no instance is a pressure of more than 15 mm. of Hg. required.

In the extraction of teeth a large gauze pack in the mouth serves to prevent oral air dilution as well as the inhalation of blood, mucus, teeth fillings or debris. It is here possible to administer the anesthetic at lower pressures and with less waste of gases although some escape will take place through the gauze.

Operations through the nose are usually associated with obstruction. Therefore, in these cases, a pressure of 1 or 2 mm. of Hg. in the mouth inhaler will be found sufficient to prevent inhalation of air through the nose. To become familiar with these pressures a mercury manometer may be attached to the anesthesia apparatus while studying the effects produced by pressure, until some definite criterion as to size of bags or other mechanical or clinical evidences have been established for future guidance without the manometer.

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CLINICAL STUDIES ON THE EFFECT OF VARIABLE NITROUS OXID-OXYGEN ADMINISTRATION ON BLOOD PRESSURE AND SOME CONSIDERATIONS OF REBREATHING IN PROLONGED ANESTHESIA.*

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From a scientific standpoint, it may be more satisfactory to have the outline of our research mapped out in the rough by a series of laboratory tests and the addition of a number of animal experiments, but many times in the course of history it has fallen to a man's lot to discover some new fact without premeditation. Honest, impartial results are more likely to be attained by this haphazard method than by the procedure, which we sometimes suspect has been used, of placing a result to be reached before the mind of the investigator and urging (or at least suggesting to) him that he ascertain what facts there are to support the theory. Among other examples of accidental science or scientific accident, according to popular report, is the story that Newton discovered the law of gravity in a moment of abstraction while

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not consciously engaged in the problem, and, at the risk of carrying you from the sublime to the ridiculous by such close association with an immortal name, my results in the study of blood pressure during nitrous oxid anesthesia were discovered simply in the routine of anesthetic work with no previous appreciation of its importance or value. Whether this informal method is the proper way to approach a medical problem is open to question. I can only quote authorities to support the theoretical considerations which underly the basis of this report, and add, as my personal contribution, the figures collected from a small clinical experience with the use of rebreathing, as the confirmation of the previously stated physiological facts.

Consideration of Rebreathing Nitrous Oxid-Oxygen.

To come down now to the specific case after these general remarks, what have we to say for rebreathing of gases in the administration of nitrous oxid-oxygen anesthesia? We might enlarge the subject to include the other anesthetic agents, and perhaps with profit, but as each agent is a law unto itself this might lead us too far from the subject with which I am more familiar.

Rebreathing is an economy in material. Perhaps it is best to mention this first, because it is the least important consideration from a surgical standpoint; yet in dealing with an anesthetic such as nitrous oxid-oxygen it has some importance, especially at a time when all chemicals, among which these gases are no exception, have doubled in value. Estimates of five dollars per hour's administration of the gases have been made and published by some workers in this line, a cost which makes the ordinary patient or the moderate priced hospital hesitate in the use of nitrous oxid-oxygen anesthesia for a prolonged operation. But when the outlay can be reduced to 30 to 50 gallons an hour, it brings the expense down within reasonable limits and allows a much wider use of this method, which is without doubt the most satisfactory anesthetic which we have now at our command. At the same time the reduction in the quantity required saves the annoyance of having to renew the supplies so often in the course of operation.

However, the item of expense does not measure very heavily against *safety*. This must be the primary consideration in every method of anesthesia; and in discussing this essential what have we on the other side of the score? Along with the historic tradition, handed down to us by the older generation (of the public at least, if not of the profession) that night air was unhealthy for breathing and should not be allowed in the sleeping room, was the conception that expired air carried some noxious substances. Probably no one would advocate one person's breathing another's expired air, but the physiologists have assured us that the expired air contains no substances harmful in themselves and have removed any possible objection to rebreathing one's own air. A prolonged clinical experience with this procedure confirms the truth of the assertion, and here the laboratory study has given us the needed encouragement to adopt and carry rebreathing into more extended use. The oxygen supply diminishes as it is used up in the vital processes, and the carbon dioxid accumulates with rebreathing. Beyond this no chemical changes in the air have been proven. Certainly clinical experience tends to bear out the assertion that no deleterious gases are manufactured in the human mechanism during rebreathing, as the anesthesia proceeds on the same even plane with the rebreathing method as with the open inhaler.

Carbon Dioxid and Blood Pressure.

Carbon dioxid is the substance which, in the expired air, is the one product having a decided effect on the vital phenomena. It is stated to be a respiratory stimulant, but with this phase of the subject we have little concern in this discussion. *The other relation to the body's activity is its blood pressure raising properties. Physiologists have claimed that an increased amount of carbon dioxid raises the blood pressure, and this action explains the results observed in a large number of blood pressure readings taken during the course of anesthesia with nitrous oxid-oxygen by the rebreathing method. And in this study both the element of asphyxia and cyanosis, which are near neighbors, have been eliminated, as neither has any part in nitrous oxid-oxygen anesthesia and must be watchfully avoided if safety is to be assured. The blood pressure reading with the open method follows the ordinary course with no elevations except for asphyxia or excitement; a gradual slow reduction depending on the length of maintenance, and a decided decrease with the advent of shock, hemorrhage or other depressing condition. On the other hand, the use of rebreathing will uniformly show an increase in blood pressure, which seems to depend on the accumulation of carbon dioxid, or whatever the blood pressure raising element is, within the bag. Ten minutes of rebreathing will raise the pressure 10 to 15 mm.; additional rebreathing will increase the pressure 30 to 40 mm, and a change to the open method has, in my experience, brought the pressure reading down to its previous level, after a sufficient time has been allowed to elapse to get rid*

of the gases accumulated in the bag. Results vary in individual cases. Some will show a very marked rise and others a smaller rise of from 8 to 12 mm., but the response has been fairly uniform throughout.

A small series of cases is not sufficient basis to formulate any absolute rules, but it can at least point the way to a larger investigation and the collection of more material along the same line. What makes one individual more susceptible or more responsive to the pressure raising action of rebreathing than another is a subject for further study. My limited experience would support the opinion that with a higher original pressure the change is likely to be more pronounced, and with the low pressures around 100 or 120 mm. the results are not so marked. However, we know that many other drugs, such as morphin and digitalis vary in their quantitative action on different individuals, preventing any mathematical exactness in the calculation and administration of dosage, and the same condition may very well apply with the agent under discussion.

VALUE OF CONTROLLING PRESSURES.

It is easy to understand of how much value this procedure may be in certain cases. Many a sick person is brought to the operating table on the very borderline between recovery and death; where the least deviation toward depression means disaster; where every ounce of resistance has to be mustered up in the final defense against disease, and in this critical hour of the fight the protection of the vasomotor system is of first importance. With all the study of the past few years in this subject by various members of the anesthetic bodies, I simply state this as a fact in passing, as much a subject of debate as the protective value of vaccine for smallpox or the appropriate vaccine against typhoid. *Yet in these borderline cases the addition of 10 to 20 mm. in the blood pressure level and the maintenance of this level must add much to the patient's vital reserves. And in a lesser degree the value of a moderate increase in blood pressure to any person with a low pressure must be a decided advantage in the course of operation.*

TECHNICAL POINTS IN REBREATHING.

A detailed description of the rebreathing method of nitrous oxid-oxygen is probably not necessary here, and would not be very enlightening. Technical measures, such as these, can be demonstrated best in actual operation and worked out, each one for himself, in every day experience. Two or three points seem important enough to be mentioned. (1) The gas bag should be kept well filled at all times, and this depends on an accurately fitting face piece, for without absolute exclusion of the outside air rebreathing is nothing more than an imaginary performance. (2) It must also be borne in mind that the oxygen in the bag is being used up continually, while the nitrous oxid is permanently present; hence the percentage basis of mixture is of no value. In the majority of cases the oxygen is being run into the bag in as large an amount as the nitrous oxid (that is a 50 per cent mixture), but this does not represent the percentages as found in the bag. (3) Cyanosis must be avoided here as in other gas anesthesias, and after the proper mixture is determined for each individual the administration becomes almost automatic.

In conclusion allow me to give you the pressure readings in a few typical cases to illustrate the results of the method. To avoid the confusion of too many figures only the sequence of the systolic reading is given; the diastolic variation following the increase or decrease in fairly regular proportion:—

ILLUSTRATIVE PRESSURE READINGS.

Case 1.—Laparotomy for removal of tube, ovary and appendix.

Preoperative pressure	100-50
15 minutes rebreathing	120
10 minutes with open valve	110
10 minutes rebreathing	126
10 minutes additional rebreathing	136
10 minutes with open valve	102-80

Case 2.—Curettage.

Preoperative pressure	84-40
15 minutes rebreathing	116
5 minutes additional rebreathing	116
10 minutes with open valve	100-62

Case 3.—Cesarian section for eclampsia, 2 oz. of urine secreted during the 24 hours previous to operation.

Preoperative pressure	158-108
10 minutes rebreathing	196
10 minutes with open valve	140
5 minutes rebreathing	154
5 minutes additional rebreathing	198
5 minutes with open valve	108
10 minutes partial rebreathing	154-108

Case 4.—Vaginal repair in a chronic nephritic.

Preoperative pressure	150-100
20 minutes rebreathing (some excitement)	162
10 minutes with open valve	124
10 minutes rebreathing	150
10 minutes additional rebreathing	164
10 minutes with open valve	126-72

519 THIRD ST.

CIRCULATORY AND OTHER REFLEXES UNDER VARIOUS TENSIONS OF ETHER VAPOR.*

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In considering the clinical effects of various ether tensions, it is impossible, of course, to deal with patients with the same degree of scientific accuracy as was used by F. C. Mann on dogs in his laboratory. We are not dealing with a definite nerve trunk from which pressor or depressor reflexes can be elicited as he reported in his article.[1]. But we are dealing with a complexity of nerves, in patients with pathological conditions and in whom the reflexes are elicited by undeterminable stimulations, such as traction and pressure of surgeon's hands and instruments. Also, the conductivity of the nerves are possibly altered by the conditions for which the patients were operated or by lueitic and non-lueitic toxins. In other words, we are dealing with patients in all their complexities just as we find them in the operating rooms.

METHOD OF INVESTIGATION.

All cases were anesthetized with gas-ether sequence by the semi-open method to the point where intrapharyngeal tubes could be inserted. The Connell *anesthetometer* was used in all cases. The anesthetometer was set at a tension of 51 mm. and then increased rather rapidly to 95 mm. This tension was maintained in most cases for five minutes, then gradually reduced to the desired tension. It is unfortunate that the anesthetometer is not as accurate as the Waller apparatus, but we believe it is of sufficient accuracy for clinical work.

In Boothby's work on *ether tension*[2] it was determined that 47 to 51 mm. were the necessary tensions for man, with the higher numbers predominating. The late Nagle found that tensions of 50 to 70 were necessary and that the lower pressures were suitable only for children and very weak patients.

TENSIONS IN RELATION TO OPERATION, OPIATES AND BLOOD PRESSURES.

In the present work, we have tried to go a little further and find out under what tensions certain operations could be performed,—that is when certain reflexes were temporarily abolished. Our work, in cases in which *no preliminary morphin* was given, is incomplete at the present time. So far we have found that a tension of 56 mm. was necessary in cases of acute appendicitis for the proper relaxation. *It was noted that in using the higher tensions that the blood pressure fell about twenty points, but was regained when the lower tensions were used at the end of the operation.*

The next series of cases, all but one of whom were females, their ages ranging from twenty to forty years, received a *preliminary dose of morphin*, gr. 1-6 and atropin gr. 1-150. The male patient, age 34, received morphin gr. 1-4 with atropin gr. 1-120. *The blood pressure ratios ran from* 34 *to* 65 *per cent.* No cases had known lueitic infections. The operations performed were of considerable variance, running from cholecystotomy to perineal repair. In these cases the intra-abdominal work was done under tensions of 47 and 49 mm. Unfortunately the perineal repairs were preliminary to the abdominal work and were done at a time when we were reaching the proper saturation, so that the tension at the time was higher than would, I believe, be necessary.

Without going into details in each case, let us pick out some interesting points. In a case of ruptured duodenal ulcer, in which the work had been done under tensions of 47 and 49 mm. and in which the blood pressure at the beginning was sys. 136, and dias. 86, the blood pressure fell to sys. 112, and dias. 78, when it was necessary to increase the tension to 56 mm. on account of rigidity during peritoneal closure. In some cases the Trendelenberg position was necessary for pelvic work; this was accomplished under a tension of 49 mm. Another case of particular interest was one of ureteral stone about one or two inches from the bladder, in which an abdominal extraperitoneal operation was performed. The patient was in the Trendelenberg position for two and a quarter hours. The working tension of 49 mm. was reached slowly over a period of thirty-five minutes. This tension was maintained for one hour and twenty minutes, when a change to 47 mm. was made and this was maintained until closure was begun, when a tension of 38 mm. was used. The total time of anesthesia was two hours and forty minutes. The pulse rate varied from ninety to one hundred and two, being ninety-six at the close. The blood pressure at the beginning was sys. 132, and dias. 88, and at the close sys. 134, and dias. 92. During the operation there was considerable pelvic manipulation, incision of the ureter and ureteral catheterization. *This would seem to show that pressures below* 51 *mm. or third stage anesthesia, can be maintained for some time without circulatory depression, even with some operative manipulation.*

In another case, in which a hysterectomy was begun while the tension was being reduced to 49 mm., we had the following behavior of pulse and blood pressure:

*Read during the Joint Meeting of the Canadian, Interstate and New York Anesthetists with the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921.

Tension	Pulse	Sys.	Dias.	Pulse Pressure	
95	...	120	80	40	Pelvic manipulation.
75	108	...	..	..	
70	...	110	68	42	
56	108	...	..	..	
49	108	114	80	34	Hysterectomy.
47	120	106	72	34	
..	...	114	78	36	
..	132	104	74	30	Salpyngo-oophorectomy.
..	108	120	78	42	
..	108	114	74	40	Traction on appendix
..	114	...	..	..	Clousure.
40	114	110	72	38	
30	96	116	78	38	

Let us consider another case in which an operation for gall-stones was done. The work was done with a tension of 49 mm. While this tension was being reached there was a fall of blood pressure, which was afterward regained when the above tension was reached. In a case of nephrectomy it was found that the work could be done with a tension of 47 to 42 mm., with satisfactory relaxation. The pedicle was cut at a tension of 42 mm. In this case there was considerable fall in blood pressure which may account for the fact that the lower tension could be used when so deep a reflex was involved.

In cases in which there exist low tensions previous to operations or low pressure ratios, tensions very much lower than those mentioned can be used. For instance, work about the hip could be done with a tension of from 38 to 30 mm. and similarly in an appendix operation the peritoneum was closed at a tension of 45 mm. *We have tried, in normal cases, to use tensions below 47 mm. for intra-abdominal work, but without success on account of the rigidity or straining. With tensions of 47 and 49 mm. the lachrynal reflex has frequently persisted, the eyeballs have frequently been rolling, the pupils small or moderately dilated and active, according to whether the patient had had morphin or had not.*

CONCLUSIONS.

From the cited cases we have reached the following conclusions:

1. The majority of surgical work can be done at a tension of 47 to 49 mm. without shock to the normal patient and that when there is pre-existing circulatory depression the tensions required are lower.

2. From our observations we also learn, in comparing them with those of previous work on this subject, that a lower tension can be used with complete satisfaction when a preliminary hypodermic of morphin is used.

3. We also note from our studies that the higher tensions of ether cause a distinct fall in blood pressure, which, if persisted in, would lead to shock.

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CLINICAL OBSERVATIONS ON THE EFFECTS OF OPERATION AND ANESTHESIA ON BLOOD PRESSURE.*

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SYRACUSE, N. Y.

Much interesting and useful information has been obtained by laboratory experiments, showing the effect various situations and conditions have had on blood pressure. In fact so much has been written about blood pressure in its various phases that it hardly seems possible that anything of value could be added. However, I would like to bring to your attention a few clinical observations in order to emphasize the practical advantages derived from the frequent use of this important means of diagnosis.

VALUE OF ROUTINE BLOOD PRESSURE READINGS.

All admit the value of blood pressure observations during operative procedures, but it is essential to take them in a more or less *routine* manner to realize their full importance. For several years I have taken blood pressure readings, though seldom recording them, on my most severe cases of shock. I distinctly recall three cases in which the patients not only left the table alive, but two of them made a complete recovery due to the timely warning I received from this data. Still it was not until about a year and a half ago, when I adopted my present system of case records, that I came to the conclusion that a frequent noting of blood pressure readings was essential to a complete anesthetic record.

METHOD.

The usual method is employed. The desk-size Tycos sphygmomanometer is used for hospital work, because of its larger and more accurate readings. The small size Tycos sphygmomanometer, with longer connections, is used for outside work, because of its portability,—a practical feature not to be despised in view of the ever insreasing aramentarium of the anesthetist. The sphygmomanometer cuff is applied to the more convenient arm, and protected from pressure by the surgeon or his assistants by a thin sheet of nickel steel, shown in Figure 3. The stethoscope it attached below the cuff and adjusted in such a manner as to transmit the sounds as distinctly as possible.

*Read during the Joint Meeting of the Canadian, Interstate and New York Anesthetists with the Ontario Medical Association, Hotel Clifton, Niagara Falls, Canada, June 1-3, 1921.

DIFFICULTIES.

The anesthetist, who is engaged in the general practice of anesthesia and gives all kinds and types of anesthetics, in places varying from the operating room of hospitals to various dental offices and private residences, finds it not always practical to take

PATIENT | NO.
ADDRESS
PLACE | DATE OPERATION
RESPONSIBLE PARTY | CHARGE
STATEMENT | PAID
AGE | SEX | WEIGHT | APPEARANCE | TYPE
PREVIOUS ANESTHESIA
DYSPNEA | EDEMA | FALSE TEETH FOOD
FOCAL INFECTION
HEART | LUNGS
T. P. R. | B. P. SYS. DIAS. P. P.
ARTERIOSCLEROSIS | ACIDOSIS
URINE
BLOOD
MEDICATION
REMARKS
ANESTHETIC | SURGEON
METHOD | PHYSICIAN
ASSISTANT
DIAGNOSIS
OPERATION
RECOVERY
NAUSEA | VOMITING
COMPLICATIONS

Fig. 1.

these readings. Yet, when a patient is experiencing or is likely to suffer from shock, I have found it well worth the bother; for the data obtained not only helps direct the conduct of the anesthetic, but also proves to be a valuable means of estimating the prognosis of the case.

Nor is it without advantage to attempt to take these readings in emergency cases, where the patient is apparently pulseless. In the past year I have had two such cases in which no readings were obtainable until the operation was about half over. But in spite of this, when the reaction to shock treatment did occur, the character and extent of the pulse rate and pressures were of great advantage in directing the postoperative treatment.

Again, the operating schedule is never so full that this feature for the patient's safety should be neglected. The anesthetist is quickly enough blamed when anything goes wrong with the patient under anesthesia. So he owes it to himself, as well as the patient, to use this safeguard whenever and wherever possible.

ADVANTAGES.

Some of the most prominent clinical fruits of blood pressure readings during operations have been

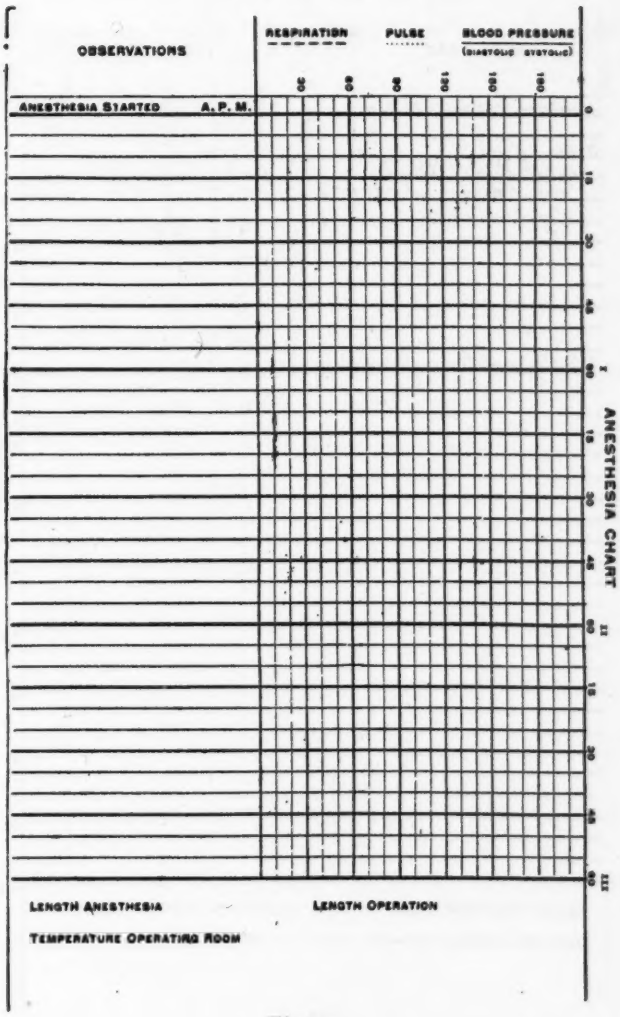

Fig. 2.

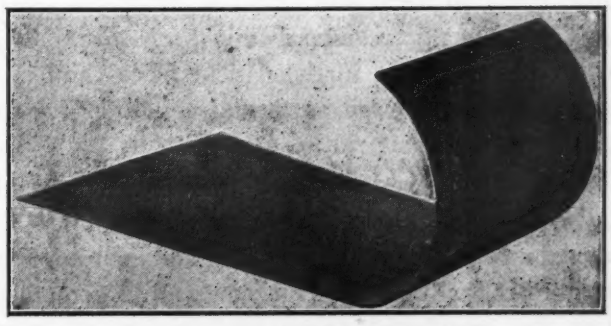

Fig. 3.

of an abstract nature in the form of an increased confidence in the patient, the surgeon and the anesthetist.

Appropriate explanations as to the object of blood pressure observations, when the arm cuff is applied, can not help but impress the patient with the extra

precaution taken for his safety. This reacts in a feeling of security, which greatly aids in relieving the tension of the moments preceding the operation. Blood pressure readings taken with and without this explanation invariably show an increased pressure when no effort has been made to define its use. The

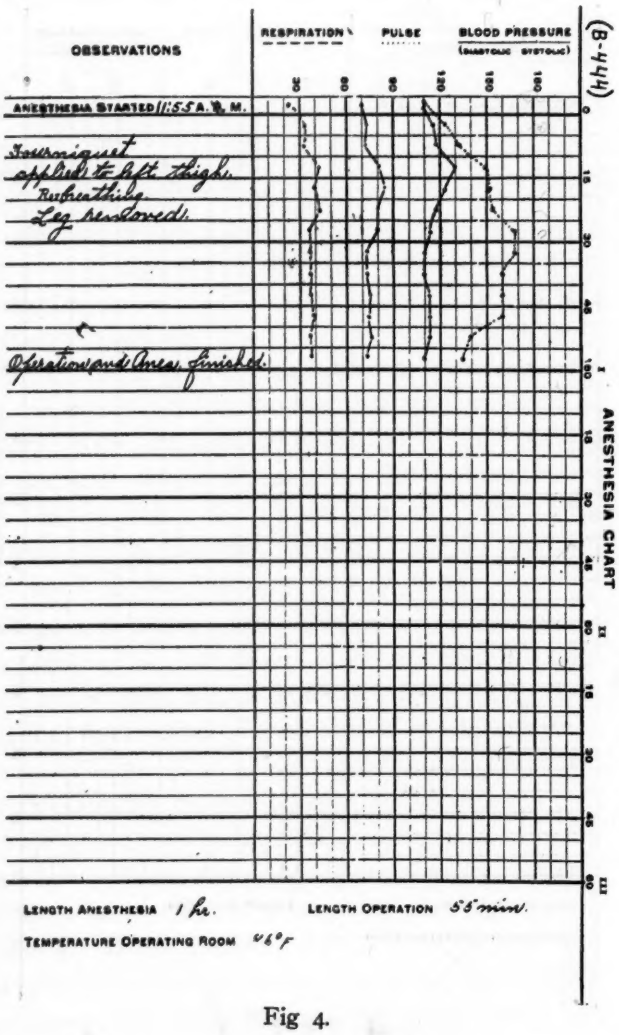

Fig 4.

these blood pressure records than the surgeon himself; and that he is willing to co-operate with the anesthetist when he realizes that in them is not only mirrored the effect of the anesthetic on the patient, but his operative technic as well. (It is also interesting to note how the *down and out* type of ether

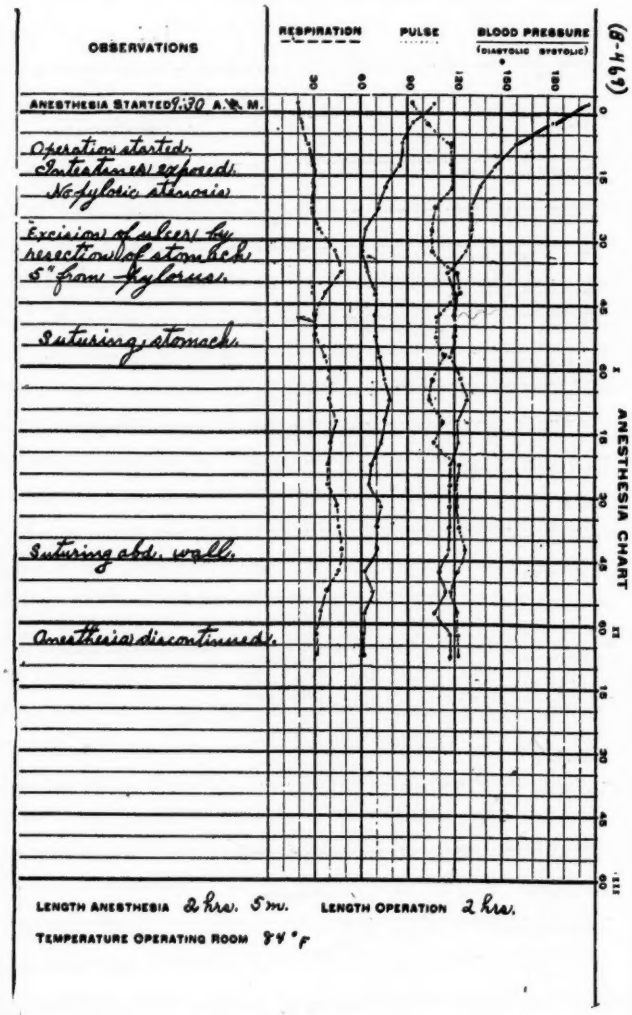

Fig. 5.

laity, quick to learn any variation from the usual, have occasionally requested this procedure. This increased confidence in the patient places him in a better physical as well as mental condition for the anesthetic and the operation.

The surgeon, to do his best work, must have his entire attention on the operation, and not be distracted with details attending the administration of the anesthetic. When the surgeon realizes upon what data the anesthetist bases his opinions, he more readily accepts his suggestions as to the advisability of more extensive operations, or the necessity of their more sudden conclusion. For it is well known that blood pressure readings give important informaeion concerning impending shock some 20 minutes before it is evident by clinical signs.

I find that there is no more interested observer of

enthusiasts, after observing their records, adopt a more gentle technic and gradually become converts to the nitrous oxid-oxygen form of anesthesia.) The words of Harvey Cushing[1], spoken in reference to brain surgery some ten years ago, were never more true than they are today when applied to all forms of surgery: "In all cases a blood pressure apparatus should be used and a running record of arterial tension kept, for this furnishes the earliest warning of impending shock."

The satisfaction this affords the operator has been expressed by a noted surgeon as follows:—"You can not tell what a relief it is to have the burden of the anesthetic taken entirely off my shoulders by an anesthetist who knows at all times the exact condition of the patient."

The anesthetist soon finds that these records of

the patient during operation remove anesthesia from the realm of guess work and chance, and place it among the more accurate sciences. To have the positive assurance of the exact condition of the patient, after experiencing the uncertainty of former methods, is a sensation that has to be felt to be described. Not only is it a check on such influences as temperature, posture, hemorrhage and surgical manipulation, but also the shock of the anesthetic itself. Any variation from the normal is distinctly shown. "How is the patient taking the anesthetic, Doctor?" —can now be answered in terms of millimeters of mercury.

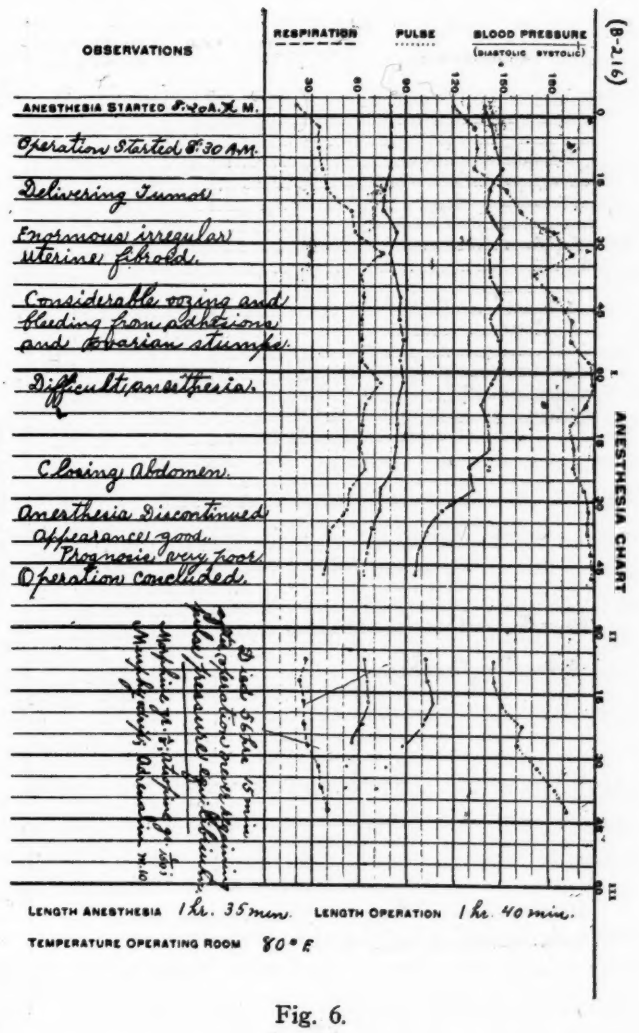

Fig. 6.

An explanation of the anesthesia record itself may be worth while. Figure 1 is the front of the record sheet, which is 8 by 5 inches in size. It can be placed in a two ring note book and easily carried in the pocket, as well as filed in any standard filing cabinet. The upper division is conveniently placed for reference data. The remaining spaces are given over to preoperative physical examination, operative information, and postoperative observations. Should the final results be unsatisfactory to the anesthetist they can easily be traced back to their cause, and thus enable him to profit the more by his experience.

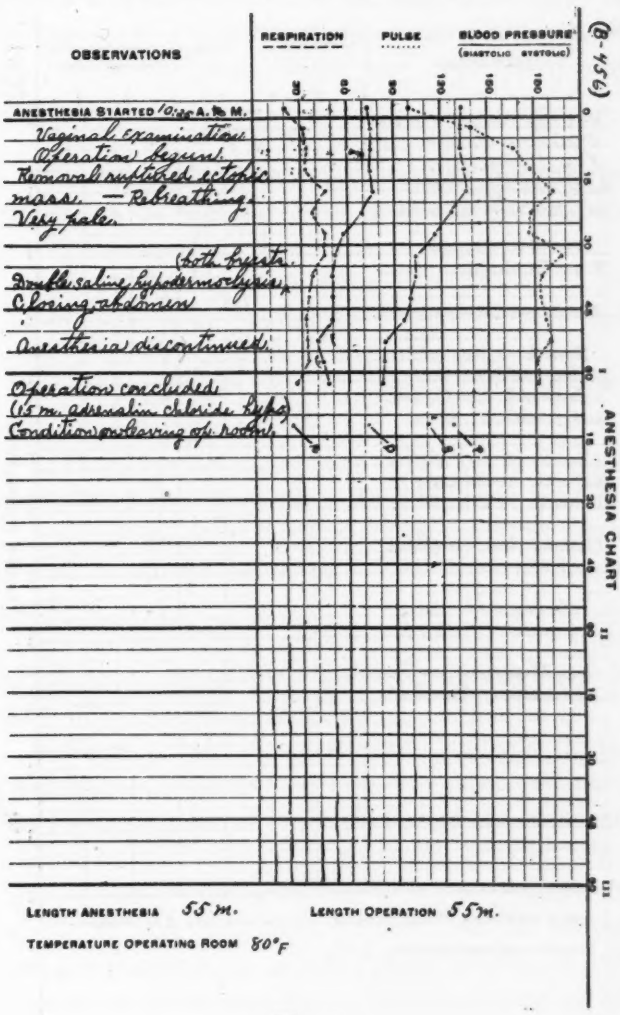

Fig. 7.

The reverse of the record sheet, or Figure 2, shows the anesthesia chart upon which are recorded 5 minute observations of respiration, pulse, and blood pressure, together with their accompanying anesthetic and operative phenomena. This is the heart of the anesthetic record, and hardly a day passes without some interesting feature developing from keeping it.

At this point I wish to express my appreciation for the incentive and help I have derived from the previous efforts along this line of such anesthetists

It is no wonder then that the anesthetist joins the patient and the surgeon in this feeling of confidence and security, when blood pressure observations accompany the administration of the anesthetic.

Illustrations.

In the comparatively short time I have been making routine blood pressure observations, I have been greatly impressed with their practical importance. The following typical illustrations will show some of these features.

as E. I. McKesson and A. H. Miller. The specialty of anesthesia is greatly indebted to them for so forcefully bringing to the attention of the profession this important feature of anesthesia.

In hospital work I use the protector for the blood pressure cuff shown in Figure 3. Especially in surgical work on the upper part of the body the surgeon or his assistants are apt to press against the cuff and so alter the readings of the sphygmomanometer. This piece of nickeled 1-16 inch sheet steel is firm enough to prevent pressure on the cuff, yet thin enough to be unnoticed by the patient. He holds it in place by lying on it, when it is inserted under the pad on the operating table.

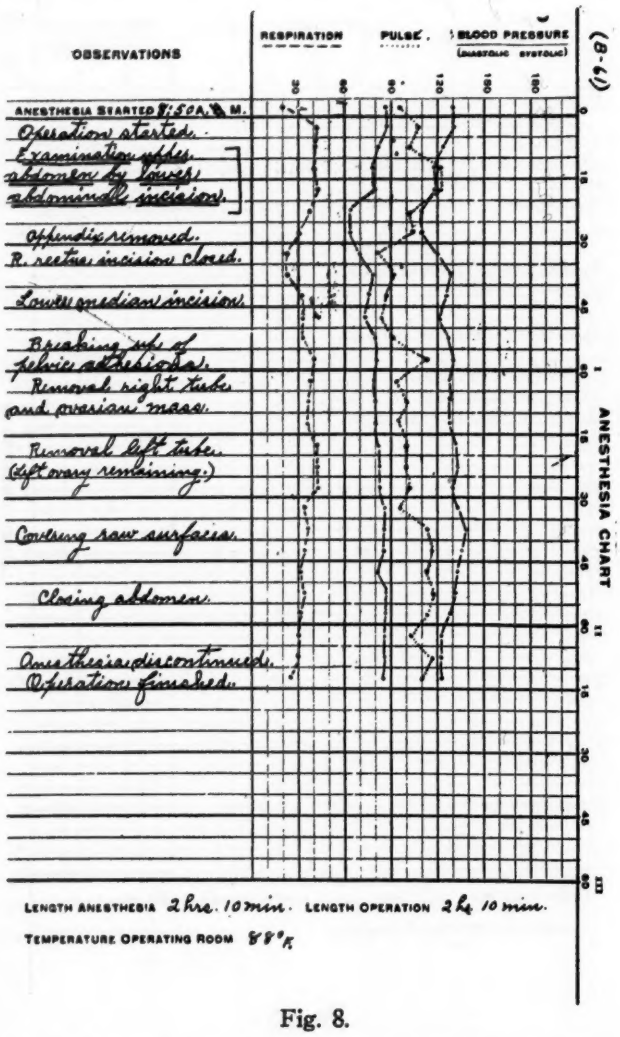

Fig. 8.

Figure 4 illustrates that *not only are the serious features of the operation reflected in blood pressure changes, but that even trivial occurrences make their impression.*

The blood pressure of this patient at the 15 minute period, especially the systolic, was produced by the elevation of the patient's leg and the application of a tourniquet, previous to the amputation at the upper third of the thigh for sarcoma of the lower femur.

Figure 5 shows an anesthesia chart of an extremely nervous person. Two days previous to the operation in the quiet of her room she registered a systolic blood pressure of 150 mm. of mercury. This was about normal for the patient, as she was 46 years of age.

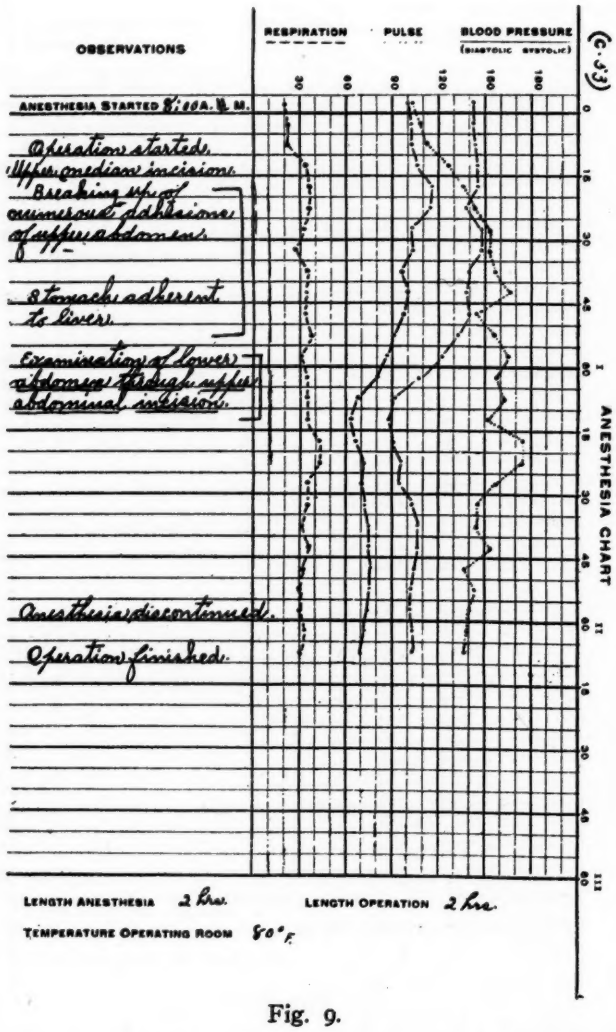

Fig. 9.

On the morning of the operation, in spite of suggestion and a preliminary hypodermic of morphin, she was excessively nervous and apprenhensive. While still in the anesthetic room, before the anesthetic was started, blood pressure readings were taken again and found to have reached the height of 208 mm. systolic and 108 mm. diastolic.

The operation performed was resection of the stomach for a large gastric ulcer. The operative shock produced was comparatively slight. It was followed by an uneventful recovery with no nausea or vomiting.

While this rise is more exaggerated than usually seen, it shows very plainly how marked may be the effect of fear on blood pressure; and why every effort should be made to eliminate or at least lessen its occurrence.

Figure 6 is typical of those cases in which an unregained pulse pressure equilibrium invariably results in a fatal termination. The operation was one of necessity—a hysterectomy for an enormous fibroid. Before the operation the systolic blood pressure was 140, diastolic 80, and pulse pressure 60mm. According to Moots' rule[2], the case was midway between, *"probably operable and probably inoperable.*

In spite of her rapid pulse, several doctors present remarked, that the patient appeared to be in good condition when she left the operating room.

The subsequent readings, taken at different times after the patient returned to her room, indicate how ineffectual all means of stimulation were, when low pressure and rapid pulse had extended over too long a period of time.

Figure 7 likewise shows an early warning of impending shock, characterized by a rise in pulse rate and an accompanying fall in blood pressure. Here a saline hypodermoclysis under both breasts was promptly established. At the end of the 55 minute period the blood pressure ceased to fall and the pulse rate began to descend. Ten minutes after the operation was complete, and before the patient had left the operating room, the pulse rate had returned to 128, the systolic pressure to 110, and the diastolic pressure to 72 mm. Subsequent recovery was rapid and uneventful.

We readily see by Figures 6 and 7, *that shock treatment to be effectual must be applied as soon as the blood pressure record shows the first signs of grave disturbance.*

In Figure 8 we have a condition common to most every laparotomy anesthesia chart,—the shock produced by examining and handling the abdominal contents. This was made at the beginning of the operation, while the patient's strength was at its best, yet there was a fall in blood pressure of 20 mm. with an accompanying rise in pulse rate. Within a few minutes conditions returned to normal and continued so until the end of the operation, when a slight drop of 8 mm. in the systolic pressure occurred, which might naturally be expected in an operation 2 hours and 15 minutes long.

Figure 9 represents a similar condition with operative locations reversed. The operation was performed in the upper abdomen. After breaking up considerable adhesions, which caused a drop of 10 mm. of blood pressure, the surgeon examined the pelvic contents from the upper abdominal incision. This continued to send the blood pressure rapidly downward and further elevated the pulse rate.

Figures 8 and 9 teach us this important lesson. *As it is impossible to eliminate exploratory manipulation, every effort should be made to have it done quickly and with the least possible trauma. Furthermore, it may still be a very serious factor, or even a fatal one, if it is not done at the beginning of the operation. The patient then has time to regain blood pressure equilibrium and is not obliged to suffer the added shock of manipulation and examination at the end of an operation, which may be in itself very shock producing.*

CONCLUSIONS.

1. Routine blood pressure examinations during anesthesia, in as many cases as practically possible, give the best results.

2. The advantages of these observations to the patient, the surgeon and the anesthetist far outweigh the inconvenience to the anesthetist.

3. An anesthesia chart is essential to a complete anesthesia record.

4. Protection from pressure on the blood pressure cuff during operations gives more accurate readings.

5. Blood pressure changes are produced by trivial as well as serious influences. The effect of fear is plainly seen.

6. Unheeded blood pressure warnings are often apt to lead to fatalities, while timely attention to them often results in recovery.

7. Examination of abdominal contents during laparotomies is always more or less shock producing and should be done at the beginning of the operation, while the patient's physical condition is at its best.

No stone should be left unturned to produce the safest and best anesthesia possible; and no method that gives us such an accurate gauge of the patient's physical condition, and such a timely warning of impending danger, as the properly recorded observations of blood pressure during operations, should be neglected.

1932 SOUTH SALINA STREET.

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2. *The American Journal of Obstetrics*, Vol. 47, p. 996, 1916.

The South is an enormous field for developing the specialty of anesthesia. On account of the sentiment attaching to Crawford Long's first use of ether, the Southern Medical Association is giving every cooperation for the organization of the Southern Anesthetists as its Chattanooga meeting, November 13-16. If you are interested in better anesthesia in the South get in touch with Dr. Wm. Hamilton Long, 1921 Duker Ave., Louisville, Ky., about membership and a paper for the program.

THE SURGICAL MANAGEMENT OF SERIOUS FOCAL INFECTION CASES, WHEN CAUTION IS TO BE EXERCISED AND WHEN SURGICAL PROCEDURE IS INDICATED.*

T. A. HARDGROVE, D.D.S.
FOND DU LAC, WISCONSIN.

There are so many diseases that can be traced to oral focal infection, that this paper will aim to deal only with patients so sick as to make dental and oral surgical operations a serious procedure. The heart, being the organ most dangerously concerned in focal infection cases, our remarks will be confined largely to cardiac complications, and they will be discussed only as they concern the oral surgeon, and more especially in relation to anesthetic and surgical risk.

This feature of the practice of dentistry and oral surgery is not receiving the consideration it deserves. Recently H. E. Friesell has assured us that the foundation branches in the dental schools will eventually be the same and as well taught as in medical schools. Then it will be easy enough to deal with hazardous cases, demanding rare judgment and selective management during joint treatment by physician and dentist. But until that time, oral surgeons should endeavor so to prepare themselves that their judgment in this field will not only be equal to, but surpass that of the general surgeon, who cannot know the patient or evaluate conditions from the dental point of view.

CARDIAC RISKS

Patients requiring rare surgical judgment are mostly those suffering from some form of heart disease. While the different *gross symptoms,* detected in the usual routine examination of the heart, are just now causing a great deal of difference of of opinion in their interpretation, it is really more important for the oral surgeon to know a good deal about high and low blood pressures, pulse pressures and heart loads, what they are caused by, and with what pathology they are associated.

In this connection Arthur R. Elliot, of Chicago, says:—

"The net result of persistent arterial high blood pressure, after due allowance is made for physiologic factors of adjustment, is overwork to the dynamic side of the circulation—the heart and the arteries.* *

"For a variable period compensatory adjustment proves adequate to maintain circulatory equilibrium, but in course of time demands on the heart, resulting from stress and strain and continued high blood pressure, outrun cardiac adaptability, and exhaustion of heart muscle takes place and circulation ceases. As observed clinically, this type of failure may manifest itself in several ways. The heart perhaps, without previous display of serious indications of exhaustion, may suddenly collapse under the strain and death takes place with the phenomena of acute dilatation. This is, comparatively speaking, an unusual form of circulatory failure in a high pressure stasis, and is most often induced by severe, sudden physical or emotional overstrain."

These conclusions bear a striking relation to a certain type of case which oral surgeons are called upon to deal with.

Illustrative Case 1.—A patient, for instance, was brought into the hospital complaining of pain and stiffness in the back; pyorrhea; infected tonsils; exaggerated knee-jerk; varicose veins in both legs; and an undefined murmur in the aortic area. Urine examination showed a specific gravity of 120; acid reaction; albumin hyaline casts, and a few bacteria. The *family history* showed father, mother and three sisters living and well. One sister died of pulmonary tuberculosis at the age of sixteen. Patient's wife and two children living and well. *Previous diseases*: Grip, tonsilitis and rheumatism, as well as an operation for appendicitis in 1903.

Present Condition: The chief complaint at this time was pain in the back and the lower lumbar region. The patient was a tall, bony, thin man. His *clinical history* was as follows: Began complaining of pain in right leg, due to varicose veins; pain radiating to right pelvis. An acute phlebitis supervened. Several weeks later he developed phlebitis in left leg. Pain and cramping in lower lumbar region were also present at this time. For three weeks the patient complained mostly of severe pain in the back, aggravated by receiving a jolt of any kind. He was weak in the lower limbs. On turning in bed he experienced severe catching pains in the back, lasting but a moment and returning with the least movement. He gave a history of renal colic recently and also thirteen years previously. He had frequency of urination and pain resembling renal colic or bladder tenesmus.

The writer was asked to see this patient in consultation and was advised by the physician to remove any infected teeth—which meant all of them. At that time the patient's pulse was not particularly rapid, and while it was not very strong, it seemed to be of fair quality. There was, however, something alarming in his general demeanor; he appeared to be apprehensive and easily shocked. It was thought best to see him two or three times before doing any extracting, in order to allay his alarm, and to detect,

*Read during the Joint Meeting of the Mid-Western Association of Anesthetists and the National Anesthesia Research Society with the Kansas City Dental Society, Hotel Muehlebach, Kansas City, Mo., October 24-26, 1922.

if possible, any changes that might occur from day to day. But upon finding him in the same condition at each visit, and upon the physician's further advice, two teeth were extracted with no bad results except a pulse of 80, if that could be considered an undesirable reaction. Three days elapsed, during which time the patient was kept under daily observation, and as he appeared to be as well, or a little better than when the teeth were previously extracted, six more teeth were removed. His condition remained about the same until the ninth day, when five more teeth were extracted. At this time he appeared to be feeling much better, and on the tenth day the patient's condition was very good. On the eleventh day four additional teeth were extracted. These teeth were all loose. The patient was feeling particularly well and slept soundly until 3:30 A.M., when he complained of shortness of breath and died at 4:45 A.M., of acute dilatation of the heart or muscle exhaustion and collapse.

The *postmortem findings* showed adhesions from the left lung to the pleura above the diaphragm; adhesion of large blood vessels to the sternum; left lung adherent at lower pole; lower left lung congested and hard, showing a mottled and consolidated area; right lung dark red, but soft (a postmortem change); no nodules or scars, heart large, pericardial fluid normal in color and amount; whitish spots present on posterior surface of heart near the large vessel; slight dilatation of the right auricle, with a thin wall, probably indicative of previous dilatations. It may be that the auricle failed with a sustained pressure. All of the valves and coronary vessels were normal except in the right auricle. Liver about one and one-half normal size, dark red in color, with sharp edges; gall bladder normal; stomach showed an old healed ulcer near the pylorus; many adhesions about the appendicial scar in right abdominal region; enlarged glands near the tail of the pancreas. It would seem that in the beginning this patient was a focal infection case that passed through all of the changes suggested by Rosenow. Spleen and left kidney slightly enlarged; otherwise normal in appearance; right kidney normal in appearance; prostate fairly large and adherent to pelvis; intestines normal.

Laboratory findings showed a mild condition of brown atrophy. Cultures were made from mottled area at once, but they were negative after three days' incubation. Liver showed central passive congestion. *Cause of Death,* acute dilation of heart. Coronary vessels appeared to have been obliterated to some extent in the walls of the auricle.

My purpose, in introducing this case record, is primarily to emphasize a consideration of the question of *shock.* As dentists and oral surgeons, we are liable to deal with shock, as it is associated with people who apparently are not particularly sick. The fact is that there are many such patients with dangerous pathology, and when the shock associated with anyhing in the nature of an operation is added to their condition, the patient's chances of recovery are jeopardized.

The temperature, in the case reported, was normal except for a short period when it went to 99.8°, and this probably made but very little difference in the fatal result. Undoubtedly this patient had lived very nearly the length of time his pathology would permit.

However, it should not be assumed, in cases of this type, that the operation has not contributed to an earlier termination of life. The patient had a history of circulatory degeneration. He undoubtedly had, due to focal infection, a gastric ulcer that healed, and also suffered from phlebitis, which never seemed to entirely cure itself. Taking the whole history into consideration this patient could not be considered a *good risk* for even extraction of teeth, and while, as a rule, the judgment of the physician in charge can be relied on, yet many times it is difficult for the physician and oral surgeon to advise as to the safety of even a slight operation, unless both are prepared to assist each other in detecting the dangers that are liable to follow in the wake of minor operations upon the jaws, when the cardio-vascular apparatus is seriously and pathologically impaired.

Illustrative Case 2.—This presents a different, but equally dangerous type of patient, suffering from sore jaw, roughly speaking, due to an infected impacted third molar, abscess and pyorrhea, and following in the wake of the extraction of one of two teeth. Within a few hours the pulse rate and temperature rose abnormally high, although remaining in regular physio-pathological proportion, but did not yield to medical treatment, until the sockets, from which the teeth had been extracted, were reopened and drained. A few days intervened before another extraction of pyorrhea infected teeth, which was again followed by the same sequence of a rapid pulse rate and temperature rise, relieved again by the reopening and draining of the socket from which the teeth had been extracted. In that particular patient, following the extraction of each infected tooth, it was necessary to maintain free drainage in order to prevent a racing pulse and rise in temperature.

This is one type of case demanding postoperative attention and pointing out the value of watching every infected case and providing proper drainage for it. The object in removing a focally infected tooth is to establish drainage, and the same surgical principle applies here as in the drainage of an abscess in any other part of the body. It is this sort of a case, if neglected after the removal of teeth, that is liable to prove fatal; but if proper attention is given, a fatality can be avoided, because the patient's pathology is not of the type beyond repair, as was that in the first case cited.

Illustrative Cases 3, 4.—Here are two more types of cases, both dangerous. *The one,* immediately dangerous on account of injury done to the different

organs by the original infection and overstrain of a weak heart muscle; *the other,* very likely a case that would do apparently well for eight or ten days or longer, but if attention had not relieved the patient, death would have resulted from general infection.

There is one type of case that you can always consider dangerous. It has been our experience at St. Agnes Hospital, Fond du Lac, Wisconsin, in handling serious focal infections, that the patient, who has had high blood pressure with consequent high pressure stasis changes in the kidneys (the symptom of which is failing function) is usually traveling in the direction of a fatal termination.

A case, that originally was one of high blood pressure with a cardio-renal complex, is of pertinent interest. It is not the patient with high blood pressure at the time of operation that is always the hazardous risk. The dangerous patient is more apt to be the one who has had high blood pressure, but whose heart is yielding to a gradual exhaustion of myocardial tonus, with the characteristic syndrome of progressive asystole, falling blood pressure and failing kidney function. Such a patient especially deserves attention when the pulse remains fast and feeble and there is an icreased number of heart beats, continuing over quite a long period of time after the extraction of one or two teeth. We are then dealing with a heart, the muscular structure of which is weakened to a point where it is dangerous to the life of the patient to do anything further in the nature of an oral operation.

The following is a short record of such a case. At the time this patient, a man, 48 years of age, who had been an electrician in the active part of his life, was brought into the hospital, a diagnosis of nephritis with a cardio-renal complex was made. He was married, and his wife and two children were living; previous diseases and injuries, none; addicted to coffee, tea and tobacco. His chief complaints were shortness of breath, dizziness, loss of strength and weight. The *dental history* showed that he had a severe pyorrhea, which resulted in the loss of five or six teeth in a few years. On admission he had eight or ten loose and infected teeth. Urinary examination indicated the presence of an advanced nephritis. The patient had a severe sense of pressure in the mid-abdomen; was pale and anemic, and had lost thirty-five pounds during the previous year. No teeth were extracted at this time because it was considered unsafe to do so. The patient was discharged, but returned in six weeks for treatment, very weak, restless and suffering from dyspnea. Six teeth and roots, all of which were very loose, were removed to get rid of the infection, according to the physician's instructions to the oral surgeon. *Oral surgery notations* indicated that the patient was a *poor risk*. On March 7, two more teeth were extracted; and on March 9, the patient was discharged, apparently improved. Following each operation, however, this patient showed a tendency to run a fast, feeble pulse, which did not improve as time went on. Having decided, therefore, to do no more extracting at this time, the patient was instructed to return later, which he did, and again appeared to be much improved. An effort was made to remove a few teeth, with a more disastrous reaction than previously. It was thought best to discontinue any further extractions at this time. *Later, following the removal of more teeth, the patient became hysterical and was hysterical all night.* In 48 hours, without consulting a physician, the patient left the hospital and went home, a distance of 40 miles. For a time he appeared to make considerable improvement, and he was anxious to have the remaining teeth removed. After taking the history of this case into consideration, and knowing that the patient had a nephritis with a failing function of the kidneys, associated with his cardio-vascular condition, it was not thought advisable to do so. In two weeks he died of cardiac failure.

It seems to be a frequent coincidence that, just previous to collapse, patients with failing circulation seem to be feeling very much better. We should not be deceived by such appearances. This case very nicely illustrates the point already stated, that high blood pressure stasis and failing renal function point to a fatal termination.

In most instances, the therapeutic measure of greatest benefit, in dealing with these cases of weakened heart muscle, is rest; but as a rule, *the rest period is not enforced long enough.* If poor risk patients are doing pretty well, surgical intervention should be delayed until rest has strengthened the heart to the point where the tax upon it, as a result of extraction operations, is not so great; as such patients are not only in danger from the reaction of their infection, but also in danger of more serious trouble from shock and the depressing effect of the anesthetic.

VALUE OF BLOOD PRESSURE GUIDES.

One of the most important guiding factors in determining the advisability of operations on patients, whose hearts may not prove equal to the strain, is the *pulse pressure.* The amount of blood pressure a patient may have is not so important as a knowledge of the pulse pressure. Whenever the pulse pressure is below one-third of the systolic pressure, there is a condition for apprehension. If it falls below 15 or 20 mm. the patient is a hazardous risk for any operation under any method of anaesthesia, local or general. In other words, when the systolic and diastolic pressures approach each other it is a sign of danger. Nor can the adrenalin, contained in the novocain or apothesin mixture used as an anesthetic, be relied upon to raise the pulse pressure, as its action is only temporary, and its reaction on the dormant bacterial factor of the disease and pulse pressure increases the associated danger. Nor can we forget that back of the patient's condition is the infection of the disease, probably dormant,

but still capable of flaring up into a disastrous reaction following operative intervention at a point of least resistance.

We must never fail to consider, in formulating judgment upon these cases, the amount of resistance to disease, or in other words, the immunity of the patient, which can best be gauged by the patient's previous history and clinical record, as well as by a comparsion with the symptoms manifested at the time of exacerbation. If, following the removal of some teeth or an operation on a focal infection area, the patient's pulse rate is increased rapidly, the temperature curve rising correspondingly, for a short period of time, and is followed by a drop of temperature so that the patient appears to have returned to normal, we have a patient who has the ability to develop a resistance or immunity to his disease. In other words, such a patient has the ability to produce antibodies to an extent that combats his disease. A favorable reaction then will be a guide as to the extent of work best undertaken and whether it should be less or more than that just done.

But on the other hand, if a patient develops a rapid pulse and high temperature curve, which do not shortly subside, then we know that we have a patient whose immunity and resistance are not strong enough to deal effectively with the underlying disease.

There is still another type of case observed clinically, which has probably escaped observation more than any other, because the patient develops a rapid heart action with only a *slight* rise in temperature, and in some instances no rise of temperature at all, but the pulse rate remains markedly fast and feeble. This is a very dangerous type of case, and without the most careful precautions is liable to succumb to the surprise of both the physician and dentist.

CARDIAC HYPERTROPHY AND MYOCARDITIS.

Occasionally we find ourselves confronted with the problem of extracting teeth for a patient who has a very much enlarged or hypertrophied heart. In some respects the hypertrophy is a compensatory measure, and while such a patient must be treated with the greatest precaution, yet he cannot be considered as dangerous a risk as some other types; and usually will withstand operative procedures that a patient with cardio-renal pathology will not.

At present physicians and dentists are being very much criticized for their unscientific and uncertain use of the diagnosis—*myocarditis,* and probably justly so. W. D. Ross in his textbook says in substance: Chronic myocarditis is a slow sclerosis of the myocardia, developing secondary changes in the coronary arteries. The essential lesion of the coronary circulation, productive of myocarditis, is a narrowing or obliteration of the lumen. The result is merely part and parcel of the general arterial sclerosis. If we must, therefore, determine just what a chronic myocarditis is, we should think first of the condition as an arterial sclerosis of the myocardia, and that its result is not liable to be confined entirely to the heart itself, but symptoms of sclerosis are apt to be found, in that type of patient, in other parts of the body.

Physical signs of chronic myocarditis are not always characteristic and distinct. They vary as the disease progresses, and in the acute form the heart sounds are usually less muscular and more valvular in quality. They are accentuated in the presence of compensatory hypertrophy, and they are enfeebled after dilatation has taken place. The aortic second sounds are frequently accentuated due to arterial sclerosis. The pulse is hard and tense, with stiff arterial walls, and is often disordered in rhythm. The area of cardiac dullness is often found extended from cardiac hypertrophy or dilatation. Murmurs are encountered in the purely valvular cases and in cases associated with cardiac dilatation.

The diagnosis of chronic myocarditis is based partially upon physical signs, but mainly upon the finding of such signs as chronic dyspnea and pulmonary congestion, which aid in suggesting the disease. So that while it may be true that the term is being rather loosely used, yet those, who are ridiculing its careless use, are not able themselves to lay down in absolute terms the diagnotic signs of myocarditis.

OTHER DANGEROUS COMPLICATIONS.

There are several local conditions that, while not dangerous to the patient's life, are a serious enough menace to health to deserve mention at this time. One of these is the statement, so often made by exodontists, that in the removal of teeth if the antrum floor is opened no great harm comes of it. In this day of preventive medicine that statement cannot go unchallenged, for the man who makes it does so without taking into consideration the nature of the bacteria liable to enter and cause disease of the maxillary sinus. I do not believe it is a wise procedure to allow Pfeiffer's or Friedlaender's bacilli or the streptococci hemolytica to enter an innocent and uninfected antrum for the reason that the mucous membrane lining the antrum is continuous with that of all the accessory sinuses. The activity of

these organisms mentioned is of such a character, that once they gain access to the sinuses, it is a very difficult matter to eradicate them and prevent their deleterious effects. As it is impossible for anybody, who opens the antrum in an operation for the removal of teeth, to know what type of infection is liable to enter it from the mouth, it becomes not only a serious but a dangerous accident.

The next type of procedure, that comes within the category of serious operations, is an heroic effort to remove the cyst wall and the bone surrounding it in the mandible. It is a far better and safer plan to cauterize the cyst wall and stimulate production of granulation loops with iodoform gauze, when the cyst has enlarged to a point where there is not a quantity of bone left to insure sufficient strength to endure the slightest strain above that used in cautious mastication by the afflicted patient. The same holds true for impacted third molars, that are infected and lie so deeply in the mandible, that in their removal the slightest pressure exerted is liable to result in a fracture of the jaw. It is saner practice, in those patients past 55 years of age, to remove the obstruction in front of the impaction, facilitating tooth removal and providing drainage, than to make the patient take the risk of a fracture. It is not often that we come in contact with such cases, and I am speaking only of the occasional case which presents itself for treatment.

During this meeting my attention has been called to the danger of dealing with patients who are hemophiliacs, but do not know it. I recall a pertinent case in my own practice, in which during the removal of a small cyst a cavity was opened where a hemotoma had formed, due to an extraction that had been made a week previously, the patient being a hemophiliac. A good deal of trouble was experienced in controlling the hemorrhage; pointing out not only the danger of a patient being a hemophiliac, but also the danger of coming in contact with a hemotoma, and emphasizing the importance of making a preoperative blood-clotting test.

REACTIONS TO LOCAL ANESTHETICS.

Since the anesthetic used in this class of work is of importance, I will present the following experiments, directed by myself upon young guinea-pigs, ranging in weight from 250 to 300 grams, to determine the comparative toxicity of apothesin and novocain so commonly used.

I wish to give full credit to Sister M. Jeanette, the pathologist and bacteriologist at St. Agnes Hospital, Fond du Lac, Wisconsin, for carrying out the technical details and tabulating the results; and to the hospital itself for its co-operation and assistance. Sister M. Jeanette received her training in this work at the Wisconsin University, which qualifies her beyond any question and I was fortunate in having her technical assistance. This work was done in association with Drs. Wiley, Smith, Twohigs and Calvey.

EXPERIMENTAL DETAILS.

1. Injected pig in heart chamber with 1 c.c. sterile water. Pig lived, showing no deleterious symptoms.
2. Injected pig in heart with 0.08 grains of novocain. Pig lived, showing no symptoms.
3. Injected pig with 0.32 grains of novocain in heart. Pig died within ten minutes, following spasm.
4. Injected pig intraperitoneally with 1.6 grains novocain. Pig lived, showing no symptoms of ill effect from the drug.
5. Injected pig intraperitoneally with 6.4 grains novocain. Pig showed marked tetanic spasms and died within four minutes.
6. Injected pig with 3-16 grains apothesin in heart. Pig died within five minutes, showing general weakness, but no tetanic spasm.
7. Injected pig with 3 3-4 grains of apothesin intraperitoneally. Pig died after ten minutes, showing general weakness.
8. Injected pig with 7 1-2 grains apothesin intraperitoneally. Pig died within five minutes, showing increasing general weakness.

NOVOCAIN USED—AUGUST 12, 1921.

1. Injected pig with 0.08 grains in heart. Tetanic spasms started immediately after injection. Spasms ceased after a time. Pig recovered entirely.
2. Injected pig with 0.32 grains in heart. Pig died almost instantly after injection.
3. Injected pig intraperitoneally with 1.6 grains. Pig lived, showing no deleterious symptoms.
4. Injected pig intraperitoneally with 1.6 grains immediately after pig had received a six-second exposure to the *x*-ray. Pig lived, showing no deleterious symptoms.
5. Injected pig intraperitoneally with 3.2 grains. Pig acted normal for about five minutes. He then showed loss of equilibrium and breathed with great difficulty. Completely recovered within an hour.

APOTHESIN USED.

1. Injected pig with 0.08 grains in heart. Pig died within a few minutes, showing a general weakness.
2. Omitted, because above was sufficient to kill pig.
3. Injected pig intraperitoneally with 1.6 grains. Pig showed slight symptoms of general weakness, which increased until one-half hour later, when pig died.
4. Injected pig intraperitoneally after a six-second exposure to *x*-ray with 1.6 grains. Pig lived, showing no deleterious symptoms.
5. Injected pig intraperitoneally with 3.2 grains. Pig died soon after injection, struggling a great deal before expiring.

PULSE PRESSURE AND ANESTHETIC DOSAGE.

You can calculate, though not exactly, the tolerance a certain patient may have by estimating the dose you would give if the pulse pressure were normal. If that pressure were 50 but is now only 25, you would reduce the dose one-half. If it were only 25 you would reduce it three-quarters. Take, for example, a patient with a broken compensation. Just at the break, your patient's circulation lost 50 per cent. of its efficiency; just how much afterward is hard to determine. This calculation of course, cannot be considered accurate, but it might be used as a basis of calculating dosage in the administration of anesthetic drugs.

CONCLUSION.

1. Oral surgeons should awaken to the fact that they are sometimes dealing with *life and death;* that they must share the responsibility of the outcome with the physician and general surgeon in cases of common effort; and must think in terms of medical and surgical pathology and be able to diagnose.

2. Serious cases should be treated in the hospital, where a good intelligent record can be made, to aid in formulating judgments that will protect and benefit such patients, and where emergency remedies are at hand.

3. One of the chief dangers of oral surgery is in dealing with a patient, whose heart muscles are weakening and pulse pressure is falling.

4. When, for instance, we find a heart and circulation going wrong and associated with functional renal failure, or nephritis, we are dealing with probably the most dangerous type of case, not so far as immediate danger is concerned, but insofar as fatality may be an end result.

5. The patient with an hypertrophied heart is not always the dangerous case.

6. The object in the removal of focally infected teeth is to establish drainage and this drainage must be maintained in serious cases.

7. The pulse pressure, properly measured, is a safety-first guide in determining the operability of cases, and the approximation of the systolic and diastolic pressures to each other is a contraindication to the use of local or anesthetics and a forerunner of shock.

8. Opening the antrum during extractions is not good practice and may lead to a serious infection.

9. To facilitate the removal of a badly infected and deep-seated impacted third molar by the removal of the obstructing second molar in front and above it, in patients past 55 years of age, is better surgical treatment than to put them in danger of fracture of the jaw at that age.

10. Experimentally novocain would seem to be safer than apothesin. The pigs dying under apothesin by their general weakness indicated the danger of using apothesin in low blood pressure.

Space does not permit further discussion, but by a greater effort on our part we can assist in an earlier detection of a beginning myocarditis, and protect and extend the lives of many patients, particularly those in whom it is caused by oral focal infection, and who must submit to oral surgical procedures under anesthesia.

COMMERCIAL BANK BLDG.

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JULY EDITORIALS 1922

AN HONOR RICHLY DESERVED.

At the organization meeting of the Mid-Western Association of Anesthetists, in Kansas City, late in 1921, the National Anesthesia Research Society set a splendid precedent by taking occasion to recognize the pioneer efforts of Dr. Arthur E. Guedel, of Indianapolis, in the revival of nitrous oxid anesthesia and analgesia in obstetrics, by the presentation of an exquisite silver loving cup with the following inscription:

IN APPRECIATION
OF THE PIONEER WORK WITH
NITROUS OXID-OXYGEN ANESTHESIA IN OBSTESRICS
BY
ARTHUR E. GUEDEL, M.D.
FROM THE
NATIONAL ANESTHESIA RESEARCH SOCIETY.

In 1910, Guedel established the routine administration of nitrous oxid analgesia and anesthesia, as we now understand it, in normal labor and operative obstetrics. Since 1912, when he presented his apparatus for, and described his technic of self-administration to the New York Society of Anesthetists, the method has come into vogue and at the present time, is being given a thorough try-out by the leading obstetricians and anesthetists of the United States.

As early as 1916, Guedel was able to report 1,800 collected cases and he used these and his own ex-

tended experience for an exhaustive paper on the subject in the American Year-Book of Anesthesia and Analgesia for 1915-16.

Since that time Guedel has devoted a great deal of attention to perfecting the technic of nitrous oxid in labor and operative obstetrics and in a symposium on the subject a tthe Kansas City meeting he presented

Dr. Arthur E. Guedel, of Indianapolis, President-Elect of the Interstate Association of Anesthetists.

his accumulated studies and experiences from the viewpoint of successfully teaching its routine use by means of graphic charts.

This honor so delightfully conferred on Dr. Guedel is richly deserved and it is to be hoped that the precedent set by the National Anesthesia Research Society will be followed by other Associations of Anesthetists in recognizing outstanding merit.—McM.

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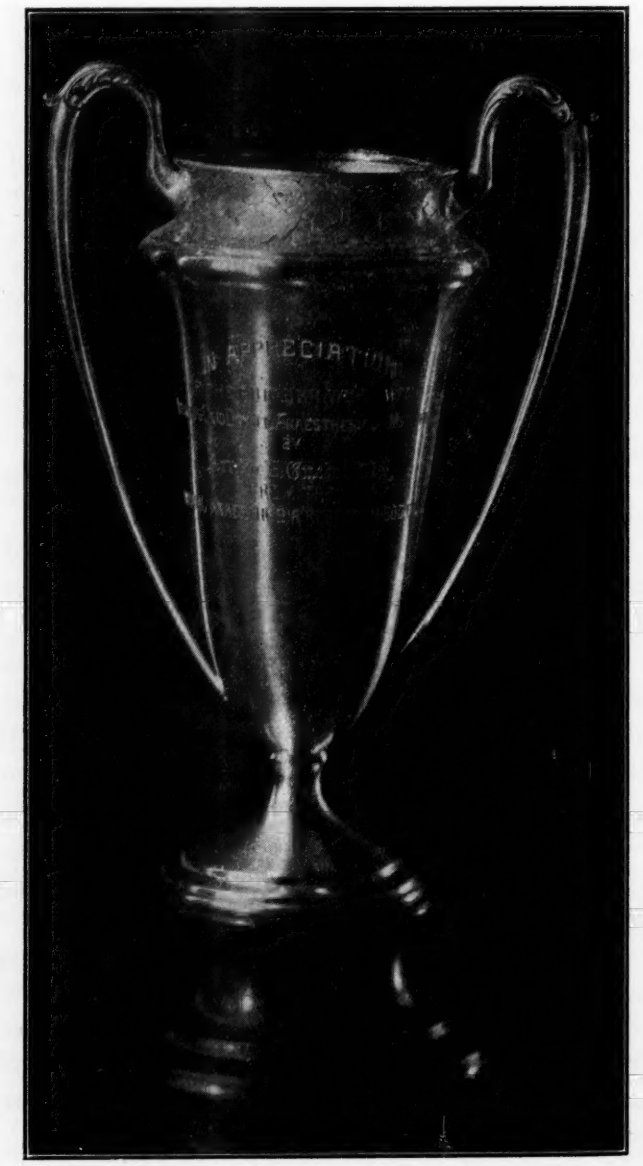

Silver loving cup presented to Dr. A. E. Guedel by The N. A. R. S. for pioneer work ni nitrous oxid-oxygen in obstetrics.

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FACTORS INFLUENCING GENERAL ANESTHESIA.*

R. STUART ADAMS, M.D.,
SAN ANTONIO, TEXAS.

It is the purpose of this paper to mention a few of the most important factors which may modify general anesthesia, and the corresponding postoperative period.

PREOPERATIVE REGIMEN.

Psychic Preparation.—So much has been written the past few years about the necessity of taking cognizance of the psychic element in every patient, that one needs only to reiterate how important it is that every one should have, from the every outset, the advantage of as calm a preoperative period as the surgeon, hospital, and anesthetist can provide. In some individuals, this will necessitate the anesthetist seeing the patient before the day of operation.

One could not have visited those clinics in which psychic preparation is used, without having been impressed with the value of preoperative mental treatment; as from the time the patient enters the hospital, every assurance is given that the operation will prove a success, and the entire nursing staff is taught the value of the right kind of mental suggestion.

Diet.—As factors in the preoperative management, that should be condemned, one cannot help but mention the starvation diet and drastic purgation carried out so religiously in former years; and one, even yet, sees these principles advocated by a few. Since it has been proven that acidosis and general postoperative discomfort as shown by increased prevalence to gas pains, nausea, vomiting, and prolonged convalescence, can only follow, it is to be hoped that these dangers will be recognized by all.

As a substitute for the starvation diet, an abundance of water, vegetables and foods, rich in carbohydrates and poor in proteins, should be allowed. Investigations have shown the value of an excess of carbohydrates and sodium bicarbonate in preventing acidosis and decreasing postoperative nausea and vomiting. Theoretically, it would seem that some monosaccharid, such as glucose, would be preferable, but for all practical purposes, cane sugar, such as is found in good candy, or maltose can be used. Kellogg advises giving 8 or 10 ounces of malt or milk sugar daily for several days previous; and 4 to 6 ounces of malt sugar, well diluted with water, in divided doses, the morning of the operation. This is given in addition to a heavy carbohydrate diet, and 3 or 4 drachm doses daily of sodium bicarbonate.

Acidosis.—Since the acid by-products are greatly increased, during the administration of any anesthetic or any surgical procedure, it is very important that the alkalinity of the blood should be maintained at its normal level. Donald Van Slyke has shown that the carriers of carbon dioxid are substances which hold alkali in combination, so that the carbon dioxid as it enters the blood is bound as alkali bicarbonate. Of these substances hemoglobin is of the greatest importance as it is capable of combining with a large per cent. of the alkali of the blood. It is only through the administration of large quantities of alkali before, during, and after the operation, that we can hope to properly maintain pulmonary ventilation, thus decreasing the per cent. of carbon dioxid in the body cells, and so minimizing the chances for the development of acidosis.

Rollin T. Woodyatt, of Chicago, has done a great deal of experimental work on the advantages to be obtained from the intravenous administration of dextrose and gum acacia during the operation. Not only is there an increased glycogen storage; but carbohydrates also aid in oxidizing the acid by-products in the tissues, have a high caloric food value, and act as a stimulant to non-striated muscle, which is shown in the rather free passage of flatus after the operation. He has found that the diuresis resulting is due not only to an increased amount of fluid administered, but to a specific diuretic action of the carbohydrates.

These factors, when taken in conjunction with the stimulating action of carbohydrates upon the heart, and the well established fact that an absence of carbohydrates result in extensive changes in fat metabolism, which cause an increased formation of acid, with greater tendency to acidosis, have led to practical application of these principles by Farrar, of New York City, who reports excellent results following the intravenous administration of a 20 per cent. glucose and 6 per cent. gum acacia solution. When given at the rate of 4 cc. per minute, not over 250 cc. at one time being introduced, assurance is given that there will be no danger from a reaction as evidenced by chills and fever.

This solution is practically of the same viscosity as the blood, and the gum acacia, which does not diffuse rapidly into the tissues, holds the glucose in solution, so that the results are not as transient as after the administration of salt solution which quickly leaves the blood stream. Saline does not undergo

*Read during the Joint Meeting of the Mid-Western Association of Anesthetists and the National Anesthesia Research Society, Hotel Muehlebach, Kansas City, Mo., October 24-26, 1922.

oxidation in the tissues as does glucose; and, after accumulating in the tissues, rapidly increases the amount of water there, with a resultant water-clogging of the patient.

W. B. Cannon has shown that the toxins thrown into the blood by the anesthetic and the traumatism of the operation, can be more readily destroyed by the liver if that organ has an abundant store of glycogen.

A special investigating committee in Great Britian, appointed during the war, decided that dilution of the blood by saline was not of special value, but that some solution should be used which corresponded to the viscosity of the blood. These principles, are, of course, not new, as Hogan and others advocated this same thing several years ago.

There is no doubt but that blood transfusion is the ideal method to be used in any case requiring a replacement of blood loss; but since it is often impossible to procure a donor of proper type, some such measure as already advocated might tide the patient over until a suitable donor could be obtained.

I have recently seen a patient with a hemoglobin index of 20 per cent., in whom three blood transfusions raised the hemoglobin index to about 50 per cent., thus enabling her to successfully withstand an operation for uterine fibroids.

Since, ordinarily, it is impracticable to give these different solutions intravenously, in any, except a small per cent. of cases, one should give gum acacia and dextrose, or glucose and soda, or saline by hypodermoclysis in all operations in the very weak individual, or in any operation which is liable to be prolonged. These measures should be started before the patient shows great evidence of their need.

Farrar has determined that only 1.8 *gms. of glucose per hour will be absorbed from the rectum; but, notwithstanding these figures, I do not believe there is any one factor of greater value to the patient than the administration per rectum of one quart of a* 5 *per cent. glucose and* 5 *per cent. soda solution, just as the peritoneum is being closed. This helps to combat the shock incidental to the withdrawal of the anesthetic, when the blood pressure begins to fall and the pulse rate increases, and it also gives the patient an abundance of fluid, which helps to maintain kidney secretion and lessens postoperative thirst.*

Professor Exner, of Vienna, had noticed that patients suffering from diabetes were usually easily anesthetized, and this led him to experiment with glucose solution administered intravenously 10 or 12 hours previous to the operation. About 40 cc. of a 25 per cent. solution being used, and the results were most encouraging.

Operations were performed upon patients such as chronic alcoholics, epileptics, and those suffering from morbid thyroid intoxication, and he was impressed by the ease with which they entered surgical anesthesia.

Further work along these lines may produce results that can be advantageously employed by all.

In 1912, Trout reported a series of 400 cases, in which plain tap water and saline were used per rectum in alternate cases, and he concluded that the water could be used longer without rectal irritation and allowed greater quantities to be absorbed. He also found less complaint of thirst in those given the water, and believed that if there were anything to the value of the salt-free diet in nephritis, large amounts of saline could only prove injurious to a kidney called upon to perform increased work. However, care should be exercised in the administration of any solution, as the patient may be given an excess which will increase the amount of water in the tissues.

Preliminary Medication.—There has never been any diversity of opinion regarding the value of preliminary medication in local, spinal, intravenous, or rectal anesthesia; so, I do not see, why all should not agree that morphin and atropin, morphin and scopolamin, or some such combination, should not be used in practically every patient, except in those having a distinct contraindication to their use.

The administration of these drugs, about forty minutes before the operation, lessens the dread of the operation, and permits a smaller amount of anesthetic to be used. In this way increasing the prospect of a more pleasant convalescence, since there will be a lessened amount of acid by-products to be excreted.

We have all seen the dire results occasioned by fear, so when this can be partially or completely removed, and the secretion of mucus can be lessened, at the same time, I cannot see any objection to the judicious use of some preliminary alkaloids and opiates.

I think great harm can be done by having a standing order as regards the amount of drug to be employed, for one occasionally sees a patient in whom a small dose will produce marked respiratory depression. However, as a general rule, we err in not giving sufficient dosage rather than an excess. I think the average adult should be given ¼ to ⅜ gr. of morphin with 1/100 gr. of atropin, rather than

the usual 1/6 gr. of morphin and 1/150 gr. of atropin.

If there is any question as to whether the patient may have an idiosyncrasy, divided doses at forty-five minute intervals, starting one and one-half hour before the operation, should be employed, thus testing the patient's susceptibility.

In this connection, one might mention the recent experimental work done by James T. Gwathmey, relative to the synergistic action of small amounts, 2 to 4 cc. of a twenty-five per cent. solution of magnesium sulphate, when added to the usual preliminary hypodermic of morphin. Gwathmey and Greenough cannot, however, explain this augmented action by a simple summation of similar pharmacologic action, for the analgesic effect of magnesium sulphate is entirely too great for this conclusion.

Gwathmey and Greenough, in their recent report on the advantages of this preliminary medication, advocate the giving of 30 to 50 cc. of a 25 per cent. solution of magnesium sulphate, diluted with sterile water q.s. 300 to 500 cc. by hypodermoclysis, starting two hours before and finishing one and one-half hour before time of operation.

I do not believe this is feasible in private practice, as the pain and discomfort incidental to such a procedure, would more than outweigh whatever added advantage there might be over the technic originally suggested by these writers.

It is needless to say that the patient should be insured against preoperative fatigue by having been given a hypnotic the previous night, a point only too often overlooked.

Upon coming to the operating room, or preferably the anesthetizing room, the patient should not be subjected to the loud talking, or rattling of instruments, so often heard. To obviate this, one writer has advocated plugging the patient's ears with cotton, and, to further quiet the patient, has considered playing the patient's favorite piece on the phonograph; and, I believe these suggestions would be very useful when dealing with an extremely nervous patient.

METHODS OF ANESTHESIA.

Gas-Oxygen.—The anesthetic should preferably be started with gas-oxygen, as unconsciousness results within forty to sixty seconds; and, if ether by the cone is to complete anesthetic, the ether can be so added after consciousness is lost, that there will be no distinct memory, if any, of its addition. The complete induction period is shortened; and gas-oxygen to the average patient is not unpleasant.

As regards the method of anesthesia, this should vary with the individual case, as there must be no one routine method of anesthesia. There can be no question but that gas-oxygen, with minimal ether through the machine for relaxation, is the safest anesthetic as regards immediate and postoperative results. Nitrous oxid is not a lipoid solvent anesthetic, as are ether and chloroform, and hence there is a minimum of by-products to be excreted by the kidneys, and toxic necrosis of the liver and kidney cells is very uncommon following its use.

The researches of G. W. Crile and T. D. Casto have shown that, whatever changes occur in the blood, after gas-oxygen anesthesia as regards hemoglobin content, hemolysis, coagulability, and cell relationship, are more or less transient, and do not at all compare with the leukopenia, lessened time of coagulability, and reduction of hemoglobin that often persists for days after the administration of ether.

As an outcome of war surgery, practically all authorities have agreed that gas-oxygen was the ideal anesthetic to give the wounded soldier, who was suffering from profound shock, sepsis, or loss of blood. They also found that metabolism was only transiently, if at all disturbed after gas-oxygen, and the phagocytic power of the leukocytes, little if any, impaired, in contrast to the well known fact that the opsonic index is not restored to normal for from two to five days after the use of ether.

Since gas-oxygen is non-irritating to the lungs and is not excreted by the kidneys but entirely through the lungs, it is the general anesthetic of choice in pulmonary tuberculosis, eclampsia, diabetes, nephritis, and in cases of a general weakened condition.

Gas-oxygen is not contraindicated in cases of high blood pressure, for McKesson and Miller have shown, in thousands of carefully kept anesthetic charts, that the blood pressure is not appreciably raised. I consider gas with an excess of oxygen, and minimal ether, the anesthetic of choice in compensated heart cases, and in cases of decompensation, in which the nervous element of the patient is predominant when a minor operation is to be performed, for there is less shock following gas-oxygen than after a local anesthetic.

The average plane of anesthesia obtainable with gas-oxygen compares to a fairly light ether anesthesia; so that if the anesthetic has to be deepened beyond this point the patient must be secondarily saturated by the McKesson technic, or ether must be added, and there must be close co-operation between the surgeon and anesthetist. The surgeon, who has been used to working with a deep ether

anesthesia, will have to use a technic in which a lighter touch is employed. The best adjuvant, to this form of anesthesia, is a complete local anesthesia, the gas-oxygen being started before the first prick of the hypodermic needle is experienced. When this method is used, according to the anocithesia technic advocated by Crile, the general anesthetic is necessary only to produce unconsciousness or analgesia and, consequently, very little ether is required.

Ether.—I think that warmed oxygenated ether vapor stands next to gas-oxygen as regards safety and minimum of after effects and in certain patients, when the operation is one that requires extreme relaxation, I believe it takes precedence over gas-oxygen-ether.

Whatever anesthetic may be employed, the aim should be to administer just as little as is consistent with the operation at hand; and the surgeon should not demand absolute relaxation which has been aptly called *dish-rag anesthesia.*

Value of Blood Pressure Readings.

Since it is often difficult to ascertain just when a patient is beginning to first show evidence of shock and loss of blood, many anesthetists, notably McKesson and Miller, are advocating the taking of the blood pressure at five minute intervals during the operation. They claim that, in this way, one can discover the oncoming dangerous state, at least 15 to 20 minutes sooner than by the estimation of pulse rate, color reaction and inspection of the patient.

Greater value is placed on the diastolic reading and pulse pressure ratio than in the systolic, since the latter is so easily influenced by extraneous factors, such as fright and temporary rough handling of the tissues and organs of the operative field.

J. O. Polak, of Brooklyn, has kept a complete record of several hundred operative cases, and has arrived at definite conclusions as regards the pulse pressure and kidney function. He considers (1) the pulse pressure the most accurate single test of the strength of the heart. (2) That the efficiency of the kidney function, provided the kidney is normal, is directly dependent upon the cardiac force of the individual. (3) That when the preoperative kidney function is low the pulse pressure must be relatively high to compensate for the deficiency, as it does no good to add saline by skin, bowel, or intravenous infusion, unless there is sufficient cardiac strength to take it up and carry it along. (4) That when both the pulse pressure ratio and *phthalein* output are low the operative prognosis should be guarded.

Postoperative Complications.

Postoperative Nausea and Vomiting.—These depend upon so many factors that it is impossible to lay the blame on any one thing. The preliminary morphin itself, in some individuals, produces persistent vomiting, and several cases of this type have been seen following local anesthesia. Unnecessarily rough handling of the intestines, or the use of several large packs, is often at fault, and the anesthetic itself, no matter what method may be employed, is often only a contributing cause. In the average person, there is less nausea after an anesthetic in which gas-oxygen with a minimum of ether is used, than any other general anesthetic. But some individuals, particularly of the highly nervous type, or those who suffer easily from sea-sickness, or the motion of a train, will be nauseated after any combination of anesthetics.

As a phophylactic, the diet and medication previously mentioned, an anesthetic which permits of a minimum of mucus secretion, and, in certain cases, gastric lavage at the close of the operation, will do a great deal towards diminishing this unpleasant complication.

Pneumonias.—The term anesthetic or ether-pneumonia should be discarded, as we now know that the anesthetic is only one of the many factors that bear upon this condition; and, since the literature mentions many cases following local anesthesia, I believe, in all justice, this term should be dropped.

Allen O. Whipple, of New York, has made an exhaustive study of pulmonary complications following surgical operations, in a series of cases at the Presbyterian Hospital, New York City. Among 3,719 cases operated during 1916 and 1917, 97 cases developed pneumonia, a morbidity of 2.3 per cent. There was a mortality of 25.7 per cent. in the 97 cases and 88 of the 97 cases followed laparotomies.

The *x*-ray was used to assist the physical findings, and, no doubt, several cases are included, which would ordniarily be classed as suffering from a postoperative reaction. Six cases were operated under local anesthesia, and in 4 of these 6, there was no history or signs of a recent or concurrent cold.

Whipple believes that the majority of surgical pneumonias are caused by aspiration into the bronchicles of the mucus of the upper air passages, which become laden with germs from the mouth and tonsils. The organism usually being the *group 4 pneumococcus,* which is present in a large number of normal throats.

When one considers that pneumonias are comparatively infrequent; and that, in the large charity hospitals of the country, anesthetics are notoriously poorly administered, every chance being allowed for

excess of mucus and aspiration, I do not believe this can be more than *one* of the many factors in the causation of pneumonias.

Cutler and Hunt recently reported a series of 1,562 operative cases from the Peter Bent Brigham Hospital. There were 55 pulmonary complications —a morbidity of 3.52 per cent.; 11 deaths—a mortality of .70 per cent.; and of the 55 cases, 25 were pneumonias. They consider the usual cause to be multiple minute emboli from the operative field, which transverse the lymphatics and veins; and, since infection is so often present, hypostasis increased by protective muscle spasm, and the constantly moving field has a tendency to loosen up thrombi; they believe the conditions are ideal for this complication after operations in the upper abdomen. They think the relationship between lung complications and operations, in the upper abdominal quadrant, can be better appreciated if one remembers that approximately 2 per cent. of all patients operated, develop these complications. This is increased to 4 per cent. after abdominal operation, and 8 per cent. when the operation is in the upper abdominal quadrant.

In this series, they believed there was a definite relationship between the ultra rapid rough operator and the frequency of these complications, and they explain this by the fact that this type of operator was more apt to stir up multiple minute thrombi.

Henle, in 1901, published a complete report on postoperative pneumonia. Of a series of 1,787 abdominal operations, three were 143 pneumonias, with a mortality of 65; giving a morbidity of 8 per cent. and a mortality of 3.6 per cent. After two hundred amputations of the breast, only two cases of pneumonia developed with one death. In goiter operations there was a morbidity of 7 per cent. with a mortality of 2 per cent.

Autopsies were performed in 52 of the 65 deaths, the results being a large excess of lobular pneumonias. Where both lungs were involved it was usually the bases and in cases of pneumonia on one side, it was usually the right lower lobe. The morbidity was 9 per cent. in males and 7.3 per cent. in females, a fact, which Henle explained by the greater alcoholic tendencies in the male, and the well-known fact that the male uses abdominal breathing more than the female, so that when abdominal breathing is interfered with by the incision and abdominal adhesive strips, pulmonary ventilation is interfered with to a greater extent. Henle also thought the loss of blood caused by a deficient circulation in the lung, which lowered the resistance of the lung tissue. The condition of the patient prior to an operation was most important, as he had a morbidity of 14 per cent. with nearly 9 per cent. of deaths in cases of gastrectomy for malignancy; while in cases of benign stenosis there was a morbidity of 9.5 per cent. with no deaths.

Local anesthesia was used extensively and the morbidity was greater; but the mortality was less than after general. He thought that in long operations general anesthesia was not as shocking as local, as the pain and excitement depressed the heart, but in those cases, absolutely free from pain, he found less pneumonias after local anesthesia.

As a point of prime importance, he believed chilling of the body should not be overlooked. Animals were anesthetized with ether and soaked with cool water, and, the controlled animals kept on thermos pillows and anesthetized. The animals exposed to chilling showed a temperature drop of several degrees. They showed every evidence of shock, and if not warmed, perished after a ten-minute experiment. In the chilled animals, the lungs showed a general hyperemia, hemorrhage into the alveoli, swelling and desquamation of the alveolar epithelium. The reverse, as to temperature drop and lung findings, was the case in the animals not exposed to chilling. This experiment was carried still further, and, the chilled animals all developed pneumonia, when sputum, containing the pneumococcus, was placed in the trachea. While the controlled animals, not chilled, did not develop pneumonia.

In patients having previous lung pathology, such as emphysema, bronchitis, and asthma, 225 were operated, and 34 or 16.6 per cent. developed pneumonia, and 17 or 8.3 per cent. died. While out of 1,393 cases, not presenting symptoms or signs of any pulmonary condition, 96 or 6.9 per cent. developed pneumonia and 42 or 3 per cent. died.

Out of 22 cases developing pneumonia after stomach resection, 14 developed this pneumonia following an aseptic healing of the abdominal wound and 35.7 per cent. died; while 8 gave this complication after a non-aseptic wound healing but 6 or 75 per cent. died, thus showing the greater mortality when sepsis is also preexistant.

From experimental work he thought there was the possibility of emboli and bacteria reaching the lungs by the veins and lymphatics. In the cases developing pneumonia from the aspiration of stomach contents and mucus he had noticed a higher mortality than from other causes.

As prophylactic measures, he considered prevent-

ing the chilling of the body surface of first importance, the avoidance of infection if possible, pulmonary exercise to increase ventilation, and frequent changing of the position of the patient of secondary importance. He warned against the injudicious use of morphin; for although it would stop the pain of the incision and render breathing easier, it at the same time lessened the irritation for expectoration. And, since expectoration was absolutely necessary in cases having a preoperative emphysema and bronchitis, he thought morphin a two-edged sword.

As one of the factors conducive to postoperative pneumonia, one must first of all mention the condition of the patient's mouth and throat. As has been aptly said, "No one ever heard of an aseptic mouth," and yet the importance of preoperative dental hygiene and the cleaning-up of decayed teeth are very often overlooked.

The patient, often accustomed to heavy sleeping garments, is given a thin night-shirt which often leaves the upper portion of the chest exposed. He is repeatedly exposed for examination, preparation, enemas, and stools. While being transported to and from the operating room the chest is often exposed to the cold draughts of the hall.

The operating table should be covered by a thick pad, and be warmed before being occupied by the patient. After completion of the operation, the patient should be thoroughly dried and dry warm garments applied. After being removed to his bed, he should, as soon as is consistent with his condition and the operation at hand, be moved often from side to side to prevent hypostasis. The dressings over the region of the diaphram should be as loose as possible, as there is no doubt that pulmonary ventilation is interfered with by the pain of the incision and tight adhesive strips.

During the anesthetic, the air-way should not be allowed to become obstructed, and the artificial metal or rubber air-way should be used in the edentulous, or the thick necked individual showing obstructive respiratory symptoms. An obstructed air-way not only increases the secretion of mucus, but, if long continued, favors pulmonary congestion, and throws an added strain upon the right ventricle.

Kidney Complications.—Following operations kidney complications are dependent upon many factors beside the anesthetic, as Allen has reported renal changes, in which one finds albumin and casts, in 60 per cent. of the cases under spinal, 66 per cent. under local, and 70 per cent. under general anesthesia. Hartleib found albumin in 78 per cent. of cases following the use of stovain intraspinally.

The kidney is often already crippled by the infection and has an increased number of waste products to eliminate, with a lessened amount of fluid to aid in this elimination, hence the large percentage of such complications. These can be partially obviated by the preoperative diet, ingestion of large amounts of water before and after operation, the administration of glucose and soda during the operation, and the selection of gas-oxygen anesthesia with as little ether as possible in cases suspicioned of being predisposed to nephritis complications.

Lung Abscess.—There have been several reports during the past few years, of an alarming number of lung abscesses following tonsillectomies. In this connection, the method of anesthesia is of prime importance, and advantage should be taken of the use of gas-oxygen under pressure or the electric motor vapor and suction apparatus. In this way, permitting a smooth uninterrupted anesthesia with most of the blood removed from the throat; so allowing, not only a clear view of the operative field, but minimizing the chances for aspiration of blood and mucus. Any method which necessitates the face mask being used, perhaps several times during the operation, necessarily allows an alternate deep and light plane of anesthesia; and, as the patient emerges from deeper anesthesia, there will be great danger of aspiration of blood because of the deep inspiration of the lighter plane.

Yandell Henderson, whose researches on various phases of anesthesia have been revolutionary, has made this statement regarding the reapplication of the mask in tonsil cases. *"If anesthetists will only realize the danger of allowing the patient to come for a few moments pretty well out of anesthesia, they will shun this practice, and the number of so-called status lymphaticus fatalities under anesthesia, will, I believe, show a sudden and marked decrease."*

In all nose and throat operations, the patient should be placed in the semi-prone posture while being transported from the operating room and the same position should be maintained in the bed. This is one of the simple measures that will help to minimize the danger of aspiration.

This paper has not presented anything particularly new, but was written with the hope that greater care may be exercised in the preoperative management of all operative cases, and that the anesthetic should be adapted to the patient and the operative procedure, rather than that the patient should be adapted to one routine method of anesthesia.

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REMARKS ON THE TECHNIC OF NITROUS OXID IN OBSTETRICS.*

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Nitrous oxid, although the safest and best anesthetic for obstetrics at our command, is meeting with some opposition in this field. The obstruction to its progress is that some do not get the good results reported by others. There is failure to reduce the suffering to the extent expected in some cases. The technic taught by some is faulty and should be corrected if this method is to survive. It should survive because it is worthy.

OVERCOMING DIFFICULTIES.

Since the discovery of the part played by oxygen in human physiology, it has been so firmly connected with the maintenance of life, the public as well as the medical profession are prone to over estimate the quantity of this gas necessary for that purpose.

The use of oxygen with nitrous oxid for obstetrics has created considerable discussion and because of popular opinion, many are afraid to administer laughing gas for this work without large quantities of oxygen from the beginning. These are failing to get the best results and the blame is unjustly placed upon the method in general, instead of upon an improper technic, where it belongs.

The value of nitrous oxid in obstetrics lies, to a great extent, in the rapidity with which it can produce a state of *analgesia.* This rapidity depends upon the concentration of the gas administered and is lessened proportionately by the amount of oxygen or air admitted to the inspired volumn.

Pure nitrous oxid will produce a *beginning analgesic response* in about ten seconds after its active inspiration is begun, which develops to *full analgesia* in about twenty seconds, from the beginning. For the same degree of analgesia, gas with five per cent. oxygen will require from thirty to forty seconds and with twenty per cent. oxygen, a minute or more. The latter two mixtures will fail of result, inasmuch as they will not produce analgesia rapidly enough to cover the labor pain.

For intermittant administration, the gas should be given in quantity sufficient to produce analgesia, which is adequate to meet the requirements of each pain from the beginning. In most cases four to six inspirations of 100 per cent. nitrous oxid is necessary to accomplish this.

Analgesia represents a certain degree of nerve cell saturation with any anesthetic agent. With nitrous oxid we do not know definitely the extent of this required saturation, but for the sake of illustration let us assume it to be 60 per cent. Full analgesia is present as soon as this saturation can be brought about, and is maintained until the gas is dissipated from the cell. Inasmuch as gas diffusion in the body is always in the direction of the lessening partial pressure of the gas in question, and the rapidity of this diffusion is proportional to the difference in degree of this partial pressure, it stands that 100 per cent. nitrous oxid will force its way through into the nerve cells more rapidly than will a diluted mixture of the gas. Therefore, the element of success in the application of nitrous oxid in obstetrics being speed, the chances for success are diminished if speed be sacrificed. To administer oxygen in any quantity at the beginning of each pain is to sacrifice speed, and the degree of this sacrifice is proportional to the amount of oxygen given.

Analgesia for each pain should be secured by the administration of 100 per cent. gas and then, after it is secured, if necessary to continue it, oxygen may be admitted in quantity sufficient to maintain tissue respiration. Oxygen for this purpose may be had from an oxygen storage cylinder or through the medium of atmospheric air.

In administering nitrous oxid for this work it must be remembered that the lungs of the average individual hold at all times about three thousand cubic centimeters of air. At least three or four respirations are necessary to displace this, and although 100 per cent. nitrous oxid be inspired from the beginning, only a diluted gas is carried to the blood until after all pulmonary air has been displaced.

The danger of nitrous oxid *without* oxygen administered from the beginning, has been exaggerated. This has created a fear in the minds of those who have not had an opportunity to study the question

*Read during the Joint Meeting of the Mid-Western Association of Anesthetists and the National Anesthesia Research Society, Hotel Muehlebach, Kansas City, Mo., October 24-26, 1922.

for themselves in the right way. This fear is responsible for those failures which should be successes under proper technic. Nitrous oxid in obstetrics is not dangerous. *Asphyxia is dangerous,* but the signs of approaching asphyxia from nitrous oxid are so well known and so marked, that this condition is easily recognized and obviated by the administration of air or oxygen when it becomes necessary.

Details of Technic.

For the further presentation of this subject I shall use charts similar to those which were published over my name in the Year Book of Analgesia and Anesthesia (1915-1916) and in the N. A. R. S. Monograph.

Chart 1.

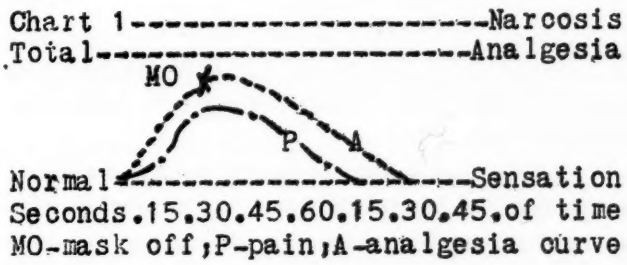
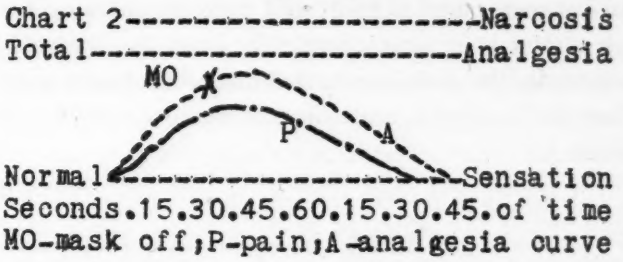


Chart 1.—Illustrates the usual pain or uterine contraction, and the manner in which the pain is covered by nitrous oxid analgesia. The mother, appreciating the approaching pain, places the mask to her face, or indicates this to the anesthetist at her earliest appreciation of its approach, and with the mask firmly in place she takes the prescribed number of inspirations holding the last and bearing down. The more or less gradual approach of the pain gives us time, if we hurry, to induce a state of analgesia which, in its rise, will keep in advance of the pain. With accession to full analgesia the mask is removed, and the recession of the state of analgesia should be slower than the recession of the pain.

Holding the breath and bearing down on the last inspiration of the gas has a twofold purpose. It both *prolongs* and *deepens* the state of analgesia and assists the mechanical progress of labor. The idea of determining the dose of nitrous oxid in this work by the number of inspirations, and that of holding the last inspiration and bearing down, originated with Dr. E. I. McKesson, and they are worthy of adoption by all of us for the average case. Many patients will refuse to thus hold their breath at the time, in spite of our urgent suggestion.

Chart 2.—Another type of pain is of slower onset and greater prolongation and requires a different technic, as illustrated in Chart 2.

Chart 2.



The slower onset here renders the necessity of speed less urgent. We know that to a given degree, a slower induction of analgesia gives us a longer duration of the state after the mask has been removed. Therefore here is a type calling for the administration of air or oxygen from the beginning in order to secure a slower induction and longer maintenance. Pure oxygen to 3 per cent. or air about 15 per cent. is a fair average for dilution in this type, eight to twelve inspirations being given.

If pure nitrous oxid be used for induction in the type of pain illustrated in Chart 2, the mask being removed at the point of full analgesia, the analgesia will have spent itself before the uterus has relaxed and the patient will feel the latter part of the pain, as is shown in Chart 3.

Chart 3.

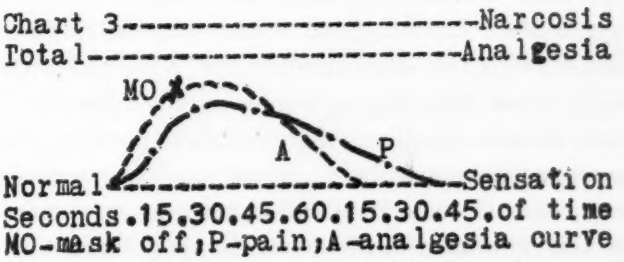


Chart 4.—Take the type in which there is a rapid onset of contraction with a prolonged maintenance or slow relaxation and the technic must be again changed. This type requires a rapid induction with 100 per cent. nitrous oxid with the addition of oxygen or air at the incidence of approaching cyanosis, this diluted mixture being held for two, three or four inspirations in addition to the number required for induction. This prolongs the rapidly secured analgesic state without asphyxial symptoms, as is shown in Chart 4.

Chart 4.

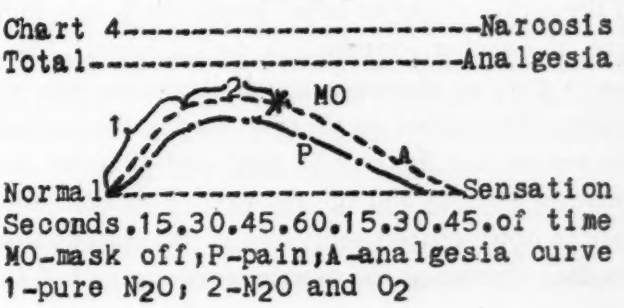
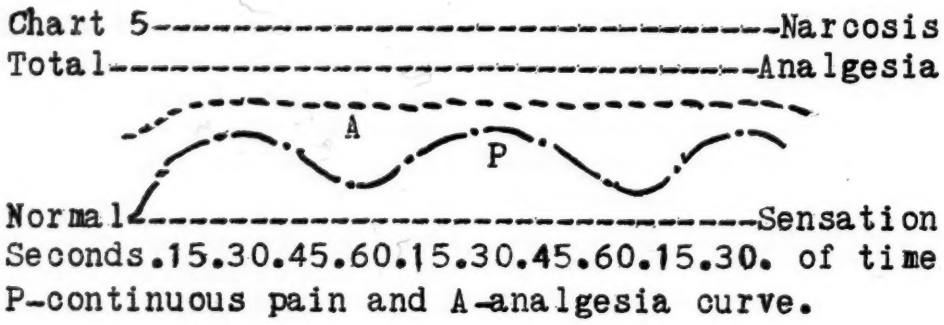


Chart 5.—Then there is the labor where the interval between pains is short and there is not time for the patient to emerge completely from the analgesia and regain the state before the onset of the next pain. Here the analgesia must be continuous as shown in Chart 5.

Chart 5.



I leave the question of the proper mixture for continuous analgesia open for discussion. I prefer a simple mixture of nitrous oxid about 60 per cent. and air about 40 per cent., varying this roughly to meet the different requirements. Or I frequently use a mixture of about the same proportions increasing the nitrous oxid content and adding a small amount of pure oxygen, say 10 per cent. In my experience the mixture of nitrous oxid and pure oxygen alone has not given results so good as those secured with the open addition of some air. It seems to me that the inspiration of any mixture of gases from a closely confined inhaler, produces, in prolonged administrations, a less satisfactory analgesia, than if some freedom of respiration without the close confinement of the inhaler, is permitted.

This type of labor sometimes requires complete continuous anesthesia to cover, in which case the state of anesthesia shall be the same as that employed for any surgical operation *not requiring relaxation.* Under complete anesthesia there often is a reduction in the frequency of the pains and whether or not the force of the less frequent pains compensate in the reckoning of labor duration, I do not know.

SELF-ADMINISTRATION.

I have mentioned the *self-administration* method. With the intelligent mother it is of value, particularly in the earlier stages of labor, because it is safe and gives the mother something to do for herself. Before I gave up obstetrics myself it was my rule to employ this method in all cases having determined the technic for the case at hand and allowing the nurse to turn on and off the gas. I mention this here in order to lend some idea of the comparative results. Assuming the average result to be had by the anesthetist at 100 per cent., the result with the self-administration method without the anesthetist would average 80 per cent. This 80 per cent. result is preferable to any 100 per cent. result as secured with ether or chloroform.

A POINT IN INDUCTION.

There is a point in the discussion of induction in all general anesthesia which is worthy of brief consideration here.

As already stated, anesthesia and analgesia depend upon a definite degree of nerve cell saturation with the anesthetic agent. Assuming that twenty seconds is sufficient to develop to the degree of analgesia, a saturation from 100 per cent. nitrous oxid, if this gas dosage is continued, the state of full anesthesia will develop in about a minute, *provided* that the rate of gas absorption into the nerve cell is normal in rapidity. If for any reason as in alcoholics, drug habitues or other stimulated types, the rate of nerve cell absorption is reduced, there will be a distinct sense of suffocation appreciated by the patient, due to the rapid displacement of oxygen from the blood, before the cell absorption to the point of loss of consciousness can occur. This sense of suffocation is often the factor which induces excitement and resistance in the patient thus rendering the induction of anesthesia more difficult.

Although this rarely applies in obstetric inductions, because of the short duration of the administration of pure gas, it nevertheless accounts for the occasional case, which, in spite of our best efforts, proves a failure with intermittant analgesia. In these cases there is the sense of suffocation developed early rendering the patient resistant and difficult to control. But the type of pain is such, (See Chart 1), that the addition of oxygen to the mixture renders the acquisition of adequate analgesia too slow to cover the earlier part of the pain.

CONCLUSIONS.

If the use of nitrous oxid is to continue its rapid progress in obstetrics there is need for a better un-

derstanding of the place of oxygen in the work. Oxygen, when it is required, is indispensable, whether taken from a storage tank or from atmospheric air. Beyond the point of necessity in maintaining proper tissue respirations, it is not required.

When it is injudiciously administered at the beginning of the pain in obstetrics, it will seriously impair the result with nitrous oxid, and it adds no proportionate safety in the case.

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OBSERVATIONS OF AN ANESTHETIST.*

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There was a time when the administration of an anesthetic was not held to be much of an art and almost anybody was considered fit to render a patient unconscious for operation. The surgeon did not hesitate to allow a nurse or a medical student inexperienced in anesthesia to etherize for him, and many a layman will boast of having etherized his wife while the doctor performed an instrumental delivery. In busy hospitals, an orderly with an ether soaked cone and a strong hand would knock the patient unconscious, and the only answer to the patient's protest were a few more strong hands pinning him forcibly to the table.

CHANGING SENTIMENT REGARDING ANESTHESIA.

Happily times have changed, and not only has the value of the skilful anesthetist become recognized by the profession, but the public also has become educated to the point where they demand special training of the physician who is to anesthetize them. To the patient the unpleasant part of the procedure is the induction of the anesthesia, which he dreads often more than the operation itself. It is therefore no wonder that specialists in anesthesia make a great appeal.

The value of a skilful anesthetist has so demonstrated itself that, at the present time, there is no well established hospital in and around Boston without one or more anesthetists on its staff, and there is no active surgeon who has not attached to his operating team some especially trained anesthetist. Not only is sound training in the administration of an anesthetic essential, but good judgment must be exercised in selecting the anesthetic for the particular patient. It is therefore safe to assume that anesthesia has become a well recognized specialty.

*Read during the Ninth Annual Meeting of the American Association of Anesthetists, Hotel Bellevue, Boston, June 6-8, 1921.

PERSONAL EXPERIENCES.

From this point of view I have kept accurate records of my cases at the Beth Israel Hospital in the hope that by study and comparison I might be able not only to improve my own knowledge and technic, but also to offer some suggestions of value to others.

During the year 1919 there were performed at the Beth Israel Hospital three hundred and ninety-nine major operations. Of that number ninety-one were anesthetized by different members of the staff, and eight by A. W. Dodge, who is the consultant anesthetist of the hospital. Two hundred were done by myself, and the rest by internes of the hospital, under my supervision. I shall report only on my own cases and those of the internes, altogether three hundred cases. The record form that we employ at the hospital is complete, as well for the preliminary examination as for the anesthetic period and the complications.

Patients.—The ages of the patients varied from two years to eighty-four. The average age was thirty-six. The operations were chiefly abdominal, but there were a large number of pelvic cases and quite a few prostates. We have no out-patient department and, therefore, there is no minor surgery. The longest anesthetic time in this series was three and one-half hours. Of all the three hundred cases there was no fatality directly due to the anesthetic.

Methods.—The methods of anesthesia were as follows: 201, straight ether; 74, gas induction followed by ether; 12, gas-oxygen; 10, spinal analgesia; and 3, local, assisted by ether.

Results.—I have divided my cases into four classes, and under *Comment on Anesthesia,* I noted on the ether chart: for first class, *Anesthesia very successful;* second class, *Anesthesia successful;* third class, *Anesthesia poor;* fourth class, *Anesthesia very poor.* If a patient went under the anesthetic smoothly without vomiting or struggling, was well relaxed for the operation, had good color all through, came out with a good slow pulse and only vomited once or twice soon after the operation, my comment was, *Anesthesia very successful.* Should the patient vomit at the time of induction or be poorly relaxed at any time during the operation, or should he be slightly cyanotic, the comment was *Anesthesia successful.* If, on the other hand, I had great difficulty in getting the patient to breathe right and if he had a poor color and was not well relaxed, my remark was, *Anesthesia poor.* Should the patient stop breathing at any time, requiring artificial means of resuscitation, such a case I designated as, *Anesthesia very poor.*

Of the two hundred and one cases of straight

ether one hundred and thirty-two, or 65 per cent., were of the *first class;* fifty-six, or 28 per cent., were of the *second class*; ten, or 5 per cent., were of the *third class;* while three cases, or 1.5 per cent., were in the fourth class.

Gas Induction.—An entirely different picture is presented by the cases in which gas was used for induction. Of the seventy-four such cases, sixty, or 81 per cent., were in class *one;* twelve, or 16 per cent., were in class *two;* while there was only one each for the *last two* classes. The advantage of gas as a preliminary to ether anesthesia can readily be seen by comparing these figures.

Gas-Oxygen.—Of the twelve cases of gas-oxygen, eight were in class *one,* three in class *two,* and one in class *three.* Of the ten cases of spinal, all were in class *one.*

Spinal.—Since January 1, 1920, our series of cases of spinal analgesia has increased considerably. I shall have more to say on this subject at a future time, when the number of cases will be large enough to draw correct conclusions. As a passing word I wish to state that for the aged and infirm, or those afflicted with disease of the lungs, heart, or kidneys, we have found spinal analgesia to be the anesthetic of choice.

COMPLICATIONS.

Pulmonary.—In this series of three hundred cases there were four complications which were directly due to the anesthetic; one lobar pneumonia, one bronchopneumonia, one lung abscess, and one parotitis due to pressure on the parotid gland while trying to keep the lower jaw forward. There were four cases of mild conjunctivitis which cleared in a few days under treatment.

With reference to the two cases of pneumonia, I believe there were other contributing factors beside the anesthetic, as for instance in the case of a woman who was coughing before operation and who on the third day developed lobar pneumonia, affecting the lower lobe of the right lung. She was operated upon as an emergency and had the gall bladder removed. It is possible that on account of pain in the incision and pressure of the wick directly under the liver, this rather obese patient could not inspire deeply with her right lung. The consequence was a congestion and a clogging up of the aveoli with a resultant pneumonia.

Tremor.—Altogether there were four patients who stopped breathing and became cyanosed during the operation. I tried to determine the cause for the accident in each case, but was unable to discover any in two cases. In one case the patient was over-etherized, as could be determined by the markedly dilated and fixed pupils.

The fourth case is worth describing in detail. This was a man of about forty-three, who was to be operated on for inguinal hernia. He was a mason by trade, and probably alcoholic. This was a case of straight ether. His aversion to the anesthetic was manifested by general twitching and stiffening of the body, what is termed an *ether clonus.* His body shivered as in an ague, and there was a peculiar twitching of the muscles of his arms, legs and face. His color was poor from the start, although he took fairly deep breaths and there was no obstruction to respiration. I began to push the ether so that his pupils became widely dilated; but the more ether I gave him, the more his body shook, and it did not stop even after twenty minutes had elapsed. I then decided to use a little chloroform which I poured on the cone by the drop method. After I used about one drachm of chloroform, the twitching stopped, and I wheeled the patient into the operating room. I continued the ether slowly. After the surgeon made the incision, before he was ready to expose the sac, I noticed that the patient was getting blue. I immediately stopped the ether. The patient in the meantime stopped breathing entirely and his pulse was not perceptible at the wrist. I ordered an ampule of camphor-in-oil and pulled his tongue out. This did not improve his condition. I then resorted to artificial respiration, and gradually he began to come back. The operation was completed, but the patient remained cyanosed and rigid throughout.

The accident in this case, I thought, was caused by the chloroform. But here I wish to remark that this patient did not have any preliminary medication of morphin and atropin. Had he received the preliminary hypodermic, he perhaps would not have come to all this trouble.

Pulse and Respiration.—I have had considerable difficulty in trying to establish from my records a standard for the pulse and respiration under anesthesia. Here I was confronted with a conglomeration of figures which could not determine any definite law as far as the anesthetic is concerned. I found the widest variations, according to the length of the anesthesia, its depth, preliminary medication, the character of the patient, and the severity of the operation. As a rule, a prolonged anesthesia raises the pulse and respiration; the same is true of rough manipulations by the surgeon. On the other hand,

some nervous patients who have a pulse of 120 before operation come down from the operating room with a pulse of about 70-80 after operation.

Pre-Medication.—In regard to morphin and atropin as a preliminary to anesthesia, I wish to state that although it should never be used as a routine, in the majority of cases it is of great benefit to the patient as well as the anesthetist. It should not be used in the aged, debilitated, and the very young. But, on the other hand, it is of great advantage to the shocked, highly nervous, asthmatics, and robust. It lessens shock, it diminishes the time of induction, and less ether is required to keep the patient well relaxed for the operation.

So much for the preliminary treatment. Now, as to induction, the use of gas as a preliminary to ether is one of the greatest additions to the field of anesthesia. Not only do we save time at the induction, but we do away with any struggling or opposition on the part of the patient in the etherizing room. It is pleasant to take, and once the patient is rendered unconscious by the gas, we can easily switch over to ether without the patient recognizing the change. It also does away with the gagging which occasionally occurs at the time of induction.

Practical Pointers.

In conclusion I wish to give a few practical points as observed from my own experience. Above all, I cannot emphasize too strongly the importance of the utmost concentration of the mind of the anesthetist on his patient. He must be on the alert all the time. The patient's color, breathing, pulse, and the size of his pupils are things that the anesthetist has to be posted on at every moment of the operation. He must also be familiar with all kinds of operations and their different stages. An operation on the gall bladder or a pelvic exploration requires a deeper anesthesia than an appedectomy or an umbilical hernia. Moreover, the different stages of any one operation require varying depths of anesthesia.

It should always be the aim of the anesthetist to use as little of the anesthetic as possible. He must be able to tell at a glance how deeply the patient is anesthetized, and for this purpose I know of nothing more instructive than the respiration. It is impossible for me to describe the different characteristics of respiration by which I am able to tell the depth of the anesthesia. This cannot be learned out of a book; one must acquire it by experience.

Another point which is of great importance is the color of the patient. One must never be satisfied with a poor color unless the patient is suffering from asthma. In about 99 per cent. of cases cyanosis means either too much ether or mechanical obstruction of the respiratory tract. Be prepared with a nasal and airway tube for every patient who has a short neck, and use it in every case where you have trouble with the patient's breathing. It saves you the necessity of continually holding forward the lower jaw. Have the head and shoulders of asthmatics higher than the rest of the body. Keep the head of short-necked people in extension.

If the surgeon remarks that the patient is rigid, never, in the desire to quickly deepen the anesthesia, pour an excess of ether on the cone all at once. The concentrated vapor inhibits the patient's respiration with the result that less ether gets into the circulation and he is likely to gag and remain rigid. It must be done slowly at the expense of a little time. If the anesthesia is so deep that the breathing becomes slow and shallow, it means that the patient is approaching a stage when he will stop breathing altogether. Stop the ether at once and wait until the respiration becomes deeper and more frequent.

There is one more important thing which contributes towards good anesthesia and which is frequently overlooked. That is the gaining of the patient's confidence. Don't enter the etherizing room and without preliminaries of any kind start the anesthetic. First get into a conversation with your patient, become acquainted, listen to his heart and count his pulse rate. Show the patient that you are there for his interest and encourage and assure him that everything will be all right. This will overcome his fright and inspire confidence, with the result that he will take the anesthetic more smoothly and will be better relaxed for the operation.

Last of all, don't consider your job finished when the surgeon gets through with the operation. You must see the patient safely in bed. During the recovery he may vomit and aspirate some of the vomitus, which may result in pneumonia or lung abscess, or his tongue may drop backward, causing asphyxia. You should see that all the moisture is wiped off his body and that he is well covered before he leaves the warm operating room for colder corridors and elevators. When put to bed, see that his head is placed in the position in which breathing is accomplished with the least exertion.

The secret of success lies in paying attention to a multitude of details which, if kept in mind, will insure satisfaction and safety.

SYNERGISTIC ANALGESIA.*

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A general review of synergistic anesthesia and analgesia, the facts upon which it is based, its advantages and dangers and details about the five different technics used at present, seems to be in order at this time.

The term *synergistic anesthesia* means the reciprocal augmentation of the action of one or more drugs upon one another with unconsciousness. *Synergistic analgesia* is the term employed when consciousness is present. When the agents are properly selected and used the resulted effect is much greater than the simple summation of their pharmacologic action.

ADVANTAGES.

Magnesium sulphate, nitrous oxid and oxygen and morphin have each proven dangerous and unsatisfactory when used alone and to the point of saturation. To avoid the dangers of nitrous oxid and oxygen when used alone, and to secure the relaxation demanded by the surgeon, in the vast majority of administrations *just a little ether* is added. Exactly what is meant by *just a little ether* may be determined by the size of the ether container attached to any apparatus, varying from a four-ounce container to a quart measure. Nitrous oxid-oxygen is uneven in results and is unsatisfactory in about 50 per cent. of cases even to dentists. Charles K. Teter, of Cleveland, O., one of the pioneers of modern gas-oxygen anesthesia for general surgery, as well as dentistry, uses a small amount of warmed ether with every dental patient. M. Ecker, a dental specialist of New York City, after an experience with over 55,000 cases now uses synergistic methods, passing the nitrous oxid-oxygen over a 50 per cent. mixture of anesthol and paraldehyde. He now has over 15,000 synergistic cases to compare. His opinion is therefore valuable. He states that each patient receives in addition to the nitrous oxid and oxygen only a few drops of the mixture, but the result is a safer and deeper anesthesia, free from cyanosis and jactitation, with no movement or flinching during the operation, rendering holding straps unnecessary for the heretofore 50 per cent. of unsatisfactory cases. With the synergists the patient is pink from start to finish, recovery is smoother, with less after hysteria and with no increase in nausea and vomiting as compared with the straight nitrous oxid and oxygen. As a sequence to the increased safety, ease and comfort of operating upon an unflinching patient, the physical and nervous strain upon the operator under the old system is entirely removed and this conservation of energy is a factor that should not be ignored.

SYNERGISM.

Until this time, the only way to avoid ether for general surgical cases and obtain a satisfactory nitrous oxid oxygen anesthesia was by using nitrous oxid-oxygen asphyxial anesthesia, or some preliminary medication, usually morphin. By administering the hypodermic tablet in a solution of magnesium sulphate instead of plain water, we can usually eliminate the unpleasant after-effects that sometimes follow morphin when given in sterile water, in addition obtaining a much longer analgesic effect.

Magnesium sulphate used alone is not a satisfactory anesthetic for human beings. Morphin-scopolamin anesthesia, according to Wood[1], in 1906, had a mortality of one death in 221 administrations. But Thorek[2], in 1921, states that this method is safe. On the other hand, a study of one-half million of administrations in the United States shows conclusively that sequences and combinations immediately increase the value of all anesthetics as regards life. Neither nitrous oxid and oxygen, nor magnesium sulphate nor morphin are deleterious to the tissues of the human body nor do any of them have an affinity for any special organ. Meltzer's laboratory experiments with magnesium sulphate over a period of thirteen years would seem to prove this. It is also proven clinically by the analysis of the liver of a patient who had received 400 c.c. of a 4 per cent. solution of magnesium sulphate by hypodermoclysis and who died on the operating table from hemorrhage after the right auricle was accidentally wounded. There was found to be 13.8 milligrams of magnesium per 100 grams of dried liver, or as the liver is 75 per cent. water, 3.45 milligrams per 100 grams of non-dessicated liver, *i.e.*, about normal. The statement by a recent writer that magnesium sulphate has a special affinity for the liver is evidently based upon an inaccurate analysis.

Nitrous oxid is neither acid nor alkaline. Upon administration no chemical changes of any kind occur in the blood, no permanent diminution of the hemoglobin, no increased hemolysis, no direct effect upon the heart, it is merely a loose physical combination. It has no effect upon the grandular system, kidneys, liver or other organs and is rarely followed by

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nausea. Death occurs from asphyxia. Used alone or with oxygen, relaxation is uncertain and fatalities have occurred. It is the most elastic of all inhalation anesthetics. If an accident occurs, artificial respiration can be immediately instituted and oxygen under pressure given without removing the mask from the face or in any way interfering with the surgeon's work. If the patient is fully analgized with magnesium sulphate and morphin, the oxygen in the gas-oxygen mixture can be increased, even to 100 per cent. if necessary.

Both of these emergencies have occurred. In one instance (after the abdomen was opened) an ovarian cyst weighing 30 to 40 lbs. suddenly burst as it was being examined. The pressure upon the heart being so suddenly removed, a collapse occurred. The patient's respiration ceased, the pulse disappeared. Artificial respiration was maintained with oxygen under pressure for some minutes, the surgeons meantime continuing their work. Respiration and pulse gradually returned, nitrous oxid was again added and the operation was satisfactorily concluded, the patient making an uneventful recovery.

If the drop method of ether had been used in this instance, physical means, such as compressing the arms against the chest and stretching them overhead would have been resorted to, with serious interference with the surgeon's work and with no oxygen or means of giving it under pressure at hand, the outcome would have been problematical. The three agents, morphin, magnesium sulphate and nitrous oxid and oxygen used synergistically produce analgesia with unconsciousness and give full relaxation of the muscles with a greater margin of safety than the usual deep third stage anesthesia with nitrous oxid-oxygen alone. The relaxation by these synergists is comparable to spinal analgesia, which gives a more complete brain block than any inhalation method heretofore used, but avoids the dangers of this latter method.

Technics of Administration.

While the method is being developed by many surgeons in five and possibly more distinct ways, the foundation of the present work was laid in a study of the charts of the Presbyterian Hospital. Here it was found that morphin, when used with a solution of magnesium sulphate instead of plain water, was increased in value 50 to 100 per cent., as regards the prolongation of its effect. Also that the syndrome following shock, including specially nausea, vomiting, wound and gas pain, was more often absent in patients treated with the synergists than with other methods, the comparison here being with nitrous oxid-oxygen, since this agent is more frequently used than any other at this special hospital. The possible objection to the Presbyterian Hospital method is its complexity and the time consumed in preparation. This time, however, is fully compensated for by the fact that little or no attention is needed for several hours after the patient is returned to bed. The Presbyterian Hospital technic is as follows and has been used in between 200 and 300 cases: The patient is instructed to take an ounce of castor oil the night before he enters the hospital. On the evening of the day of admission he is given a light supper, and is allowed to take full fluids up to midnight. From then until two hours before the operation is scheduled, he is given water and urged to drink it.

Early on the morning of the operation he is given one or two soap suds enemas. Two hours before operation he is given a 15 grain chloretone suppository; 15 minutes to half an hour later, or about 1½ hours before operation he receives a hypodermoclysis of magnesium sulphate solution. This solution is made up in the operating room and contains 4 per cent. of chemically pure magnesium sulphate, sterilized and kept in a heater. The amount varies from 350 c.c. for asthenic or cachectic individuals up to 400 c.c. for normal adults, or up to 450 c.c. for heavy muscular patients. To this solution is added, just before injection, 30 c.c. of a 1½ per cent. novocain solution. This addition of novocain is used with all hypodermoclyses at the present time with the result that it materially diminishes the discomfort attendant upon the injection. The temperature of the solution as it is running in is kept at about 110° F. by immersing the flask in a hot water bath.

A long rubber tube is placed in the flask and led down to the patient. It branches near the lower end, and two hollow needles, three inches long, are attached to the ends. The flow is kept up by gravity and controlled by hemostats applied to the rubber tubing. The skin under the breasts or on the front of the thighs is sterilized with iodin, and the needles are inserted either under the pectorals running up toward the axilla, or into the thighs running down to the fascia. About 15 to 20 minutes are allowed for the solution to flow in. More time may be allowed if the rapid distention is very uncomfortable. For inserting the needles, we sometimes inject a drop or two of novocain in the skin. The whole proceeding is, of course, done aseptically. No sloughs or abscesses have occurred. With this technic a definite specific action from magnesium sulphate can always be relied upon.

In addition to the suppository and the clysis, 3 doses of morphin are given at 15-minute intervals, the first an hour and a quarter before operation. The morphin is divided in this way in order that if the patient shows an idiosyncrasy, it will be apparent before the third dose is given.

After the clysis and morphin have been given, the patient is screened and kept quiet until going to the operating room, and at all times every opportunity is given the patient to fall asleep.

Sometimes the skin is prepared for operation before starting the anesthetic; sometimes the anesthetic is given first. Nitrous oxid-oxygen is used in all cases, and ether only if necessary. The start is usually with 1 litre of oxygen and 8 litres of gas, but within 15 minutes an increase in the amount of oxygen can be made. In many of the cases it has been found possible to stop the administration of nitrous oxid entirely half an hour or an hour before the end of the operation. If the relaxation is not sufficient at the start of the operation, a few drops of ether are added to establish it, with a prompt return to the nitrous oxid-oxygen. About 90 per cent. of the cases receive no ether at all. When given, fifteen minims to two drams is the usual amount. One of the objectives of the Presbyterian Hospital technic is to abolish or reduce to a minimum the use of ether.

PRECAUTIONS.

With this technic the *margin of safety* is represented by the nitrous oxid-oxygen. If a patient is only slightly affected, ten to thirty-five per cent. oxygen is the usual ratio, or if unduly susceptible to the preliminary medication, the oxygen may be increased to 50 or even 100 per cent. By the time the operation is completed, the peak of the effect of the synergists is passed and consequently the patient is out of any possible danger that might be attached to this method, although a twilight slumber may last for several hours. It is a curious fact that although morphin, magnesium sulphate and nitrous oxid have their final effect upon the respiratory center, only in two or three cases in this series was respiration reduced to a marked degree. The average respiration with all is twenty. Furthermore, if the respiration is reduced below normal at any time, it can be quickly remedied by the following simple procedure: Place a mask upon the face, with an empty bag attached, catching the expiration in the bag, raising the mask again upon inspiration; and repeating this procedure several times, or until the bag is about one-half or two-thirds filled. Then hold the mask tightly upon the face. The respiratory center will be quickly stimulated by the patient's own carbon dioxid. Cyanosis can be remedied by adding a little oxygen continuously or intermittently, as necessity demands. The patient's respirations will quickly rise to normal and remain so. This simple procedure may be the solution of safe morphin analgesia.

MAGNESIUM SULPHATE-MORPHIN SYNERGISM.

We know now that magnesium sulphate synergizes with morphin in the same way that it does with ether, as the following laboratory experiment proves.

In collaboration with E. S. Tibbits a number of laboratory animals of the same weight and size were anesthetized in the following manner: Using 1/8 grain of morphin with all of them, and dissolving the tablet in a 4 per cent. solution of magnesium sulphate, no anesthetic effect was produced with one to four c.c. of the solution. With 5 to 9 c.c., an anesthesia lasting two hours was secured; with 5 c.c. the anesthesia was light, but with good relaxation; with 9 c.c. the respirations were so reduced that while no artificial respiration was necessary, it was deemed useless to go further. Thus we see that we have a margin of safety with morphin and magnesium sulphate that is as great as with any of the other narcotics. These experiments would seem to controvert the statement of some writers that morphin and magnesium sulphate are poisonous.

SYNERGISTS AND ETHER-OIL COLONIC ANESTHESIA.

Among other methods attempted upon human beings with the synergists was an attempt to reduce the amount of ether used in colonic anesthesia, with the object of rendering expert supervision unnecessary. With the usual colonic anesthesia all the muscles of the body are relaxed, including the tongue, thus requiring an anesthetist at the head of the patient to maintain a clear airway. With the idea of increasing the analgesia and decreasing the third stage anesthesia, magnesium sulphate and morphin were added and the ether decreased. While some brilliant results were obtained, the new method was irregular and not so satisfactory to the surgeons accustomed to the usual oil-ether colonic anesthesia, and consequently I have not been able to personally push this method. We gave what data we had to Joseph M. Rector, of the Jersey City Hospital. The technic has been modified in his clinic from time to time and he now has a record of over 200 cases operated upon by himself in the Jersey City Hospital. His technic is as follows:

Two soap suds enemas at night and 2 clear water enemas in the morning. Two and one-half hours before operation a hypodermic of morphin, gr. 1/4

and atrophin gr. 1/150. Two hours before operation insert rectal tube 18 inches into the sigmoid and let it remain *in situ* for 15 to 20 minutes until all gas is expelled. Then instil slowly the following mixture:

Magnesium sulphate, 25 per cent. C. P. solution .....7 ounces
Ether .....2 ounces
Oil .....1 ounce
Glucose .....1½ ounces
Pulverized acacia q.s. to make emulsion.
Morphin .....¼ grain
Paraldehyde .....4 drams

Clamp tube and leave in place until patient comes to table. Cover face with towel. For incision of skin and peritoneum inhalation may be needed. The remainder of the operation can be done with the synergists alone. The patient remains quiescent, no nausea, vomiting, wound or gas pains, except in two cases.

This record cannot be equalled by any inhalation third stage anesthesia method. While it is questionable how much magnesium sulphate is absorbed when given by this method, there is certainly enough to give definite results before, during and after operation.

Other Methods.

Some surgeons object to the usual routine of a patient's life being interfered with in any way until just before coming to operation. This attitude is responsible for the third and simplest of synergistic methods, which is as follows:

A ⅛ grain of morphin and 1/200 of hyoscin tablet is dissolved in 3 to 5 c.c. of a 25 per cent. sterilized and chemically pure solution of magnesium sulphate and this is given by hypodermic one and a half hours before operation and repeated once or twice at 20 to 30 minute intervals, the patient receiving not over ⅜ of a grain of morphin and 1/66 of hyoscin and 9 to 15 c.c. of the mixture. This is supplemented at operation by nitrous oxid-oxygen and if anything further is needed to secure relaxation the gases are passed over one dram of paraldehyde, ether being thus entirely avoided.

The fourth method was developed in association with certain surgeons, especially Dr. Solomon Rottenberg of the Peoples Hospital, and is as follows:

Two soap suds enemas are given at night and two clear water enemas the following morning. Two hours before operation give a 15 grain chloretone suppository. One and one-half hours before operation a retention enema is given of 200 c.c. of a 4 per cent. solution of magnesium sulphate with two to four drams of paraldehyde and in addition two or three hypodermics of morphin, as already just described. This is supplemented by nitrous oxid-oxygen by inhalation. While this method is more satisfactory than the three hypodermics alone, yet in neither of these methods nor with the Rector technic do we get the marked analgesic and hypnotic effect from the magnesium sulphate as when given by hypodermoclysis.

The fifth method is that of Glass[3] and Wallace and is called the alkaline synergistic method and is as follows:

Each patient receives sodium bicarbonate 15 grains (1 gm.) and lactose 5 grains (0.3 gm.) every four hours for 6 or 8 doses before operation, in order to have the patient thoroughly saturated with the carbonate.

For immediate preoperative treatment give one and one-half hours before operation a hypodermoclysis of a 4 per cent. chemically pure and sterile solution of magnesium sulphate 200 c.c. and at the same time a hypodermic of morphin sulphate 1/10 to ⅛ grain in 1:5 c.c. of a 25 per cent. chemically pure and sterile solution of the magnesium sulphate repeated at 15-minute intervals for two or three doses. The inhalation anesthetic is ether and is given by the drop method. The patient is in analgesia when the ether is started and the excitement stage is *nil*. Without the synergists the average amount of ether is 8¼ ounces and the average time for a postoperative sedative 5 1/3 hours, compared to 5¼ ounces of ether and 17 hours of analgesia with the synergists, the operating time being the same—about one hour and 21 minutes.

Their conclusions follow:

1. The sedative action is prolonged to such an extent that morphin postoperatively is rarely needed and the sedative effect is greater with morphin than with pantopon.

2. There is very little paresis of the intestines and less acidosis; nausea and vomiting are practically eliminated, except when the gall-bladder has been emptied or removed.

3. The amount of ether is lessened, thus reducing to a minimum bronchial and renal irritation and also causing less acidosis.

4. There is no distention and no gas pain.

5. No deleterious results, such as abscess, necrosis of tissues or laxative effect, follow the use of synergists.

6. The postoperative condition is entirely altered;

absence of gas and wound pains and no distention, with subsequent improved appetite and lessened mental depression, makes convalescence shorter and more agreeable.

All five methods may be used, with modifications, on adults between 17 and 70 years of age, the vitality or general condition of the patient being of much more importance than the age and weight.

DANGERS.

As in all other methods of general and local anesthesia, certain things must be avoided. To superimpose a third stage inhalation anesthesia of nitrous oxid-oxygen, or of ether, upon any synergistic method is dangerous. Loss of lid reflex or cyanosis cannot be allowed. The patient should be kept pink at all times.

The greatest danger with any synergistic method is in the possible masking of all shock symptoms. Whenever an operation is undertaken in which the mortality is known to be very great, even if the patient is pink, with pulse and respiration normal, shock measures should be instituted.

CONCLUSIONS.

When properly given and safeguarded, certain things are common to all five methods here outlined:

First: The patient's condition, when brought to the operating room, varies from a seemingly normal condition to unconsciousness. The conscious patient may answer questions intelligently, immediately before and after operation, but when placed in bed will rest quietly for several hours. Upon awakening he remembers little or nothing of the operation, and in fact some patients do not know they have been operated upon until told.

Second: Nausea, vomiting, wound and gas pain are more nearly eliminated by synergistic methods than by any third stage inhalation method, even the best.

Third: When supplemented by nitrous oxid-oxygen or by ether given to unconsciousness, or by local analgesia, the patient is not cyanosed at any time, neither is the alkali reserve even temporarily lowered. These two factors may account for the absence of nausea and vomiting in so many cases.

40 E. 41ST ST.

1. H. C. Wood, Jr.: *American Medicine*, December, 1906.
2. Max Thorek: *Ill. Med. Journal*, Vol. 39, June, 1921.
3. Glass and Wallace: *Jour. A. M. A.*, Jan. 7, 1922. Vol. 78, p. 24.

SYNERGISTIC ANALGESIA: CLINICAL OBSERVATIONS.*

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All operative measures call upon the body for a display of its vital force. The innate power residential in that body, is *primarily* its created individuality, *secondarily* its peculiar growth and *thirdly* the conservation of its organs and functions to so respond that the constant drain will be a measure of equality between waste and repair. The daily needs are supplied by the constantly recovering reparative energy, which in itself is but the potential of the body changed into its motive power. The response of the body in answer to an immediate summons will be proportionate to its potential and its ability to properly control its kinetic force. All stimuli, be they conscious perceptions, emotional forces, instrumental injury or surgical trauma, with or without inhalation anesthesia, set into motion the kinetic system with consequent discharge of stored energy in the cells of the brain, resulting in stimulation, overstimulation or final exhaustion.

SYNERGISM.

The English word *synergist* is of Greek derivation, composed of the preposition *sun* and the noun *argon* from which *sunargon* is formed, meaning: working together with, along with, at the same time, but more aptly applied, a medicine which aids or co-operates, and synergistic, acting with another medicine or agent.

The bringing together of drugs in interaction may result in consequence, effect, issue, sequence or eventuation; the action may be altered, modified, lessened or accentuated, or in effect a new principle may be evolved, whereby another discovery will be added to the many now placed at the service of suffering mankind. The inter-relationship of the drugs which are used in synergistic combination result in reciprocal augmentation, the final results being the production of an analgesic state.

Anesthesia is one of the properties of magnesium sulphate and in the synergist analgesic chain, acts as a base from which is formed the co-operative action of this combination. It is a powerful medium in hastening the absorption of the morphin and probably also retards the formation of the oxid-morphin, which is produced in the process of oxidizing the morphin in the body. This explains the increase in

*Read during the Anesthesia Session of the Section on Miscellaneous Topics of the American Medical Association, at the St. Louis Meeting, May 24, 1922.

value of the morphin, and may be readily substantiated by chemical test dependent upon the reduction of permanganate of potash by morphin. Dissolve 1 gm. of magnesium sulphate c.p. in 100 mils. of distilled water contained in a flask of 125 mils. capacity, add to this solution .016 gm. (gr. ¼) of morphin sulphate previously dissolved in 5 mils. of distilled water. Dissolve .016 gm. of morphin sulphate in 105 mils. of distilled water, contained in another flask of 125 mils. capacity. Upon adding 10 mils. of n/10 (deci-normal) solution of $KmNO_4$ solution to the plain morphin solution, instantaneous reaction ensues in the second solution, the color of the liquid changing to mahogany brown, while the manganese dioxid in precipitated and the morphin is converted into oxid-morphin. Upon adding the n/10 $KmNO_4$ solution to the $MgSO_4$ morphin solution a similar reaction occurs, but not as pronounced as that occurring in the plain morphin solution. The color reaction is not as deep and the amount of the manganese dioxid precipitated is only half as large.[1] The action of magnesium sulphate used hypodermatically, intramuscularly or intraspinally for the restraint of muscular spasm and convulsive seizures needs no further reference here.

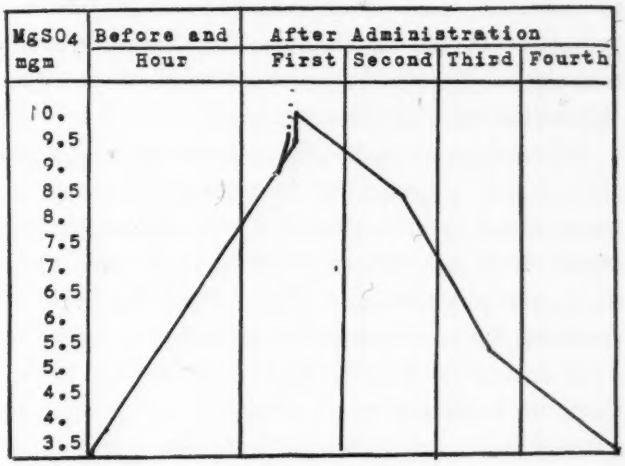
Magnesium Content of the Blood.

During my clinical work at the Jersey City Hospital it became interesting to know the magnesium content of the blood, following the rectal use of seven ounces of a 25 per cent. solution. Dr. St. George, the Director of the laboratory, made the following test:

Magnesium determinations on the blood of five patients were made according to the method of Kremer and Tisdal (*Journ. Biol. Chem.*, Aug., 1921, Vol. 47) at hourly intervals for a period of four hours. It was found that the magnesium reached its maximum concentration in the blood within one hour after its administration and thence gradually diminished returning to normal at the end of four to five hours. In the five cases the normal magnesium content of the blood was found to average between three and four milligrams per 100 c.c. of serum. At the conclusion of one hour the maximum concentration averaged 9.5 to 10 mgm. of magnesium. Two hours later the average was 8.5 mgm.; three hours later 5.5 mgm.; and four hours later 3.9 mgm. per 100 c.c. were found. These figures are higher than those obtained by James Greenough (personal communication) of the Presbyterian Hospital, New York City, though he used a technic somewhat different than the one noted in this paper and gave different amounts of the solution. However he obtained a curve similar to that given herewith.[2]

CHART I

Magnesium Concentration in the Blood



The Morphin-Magnesium Sulphate-Ether-Paraldehyde Combination.

Morphin sulphate, in its general employment, is not of peculiar interest at this time, but in this class of work it is of importance. Small repeated doses of morphin sulphate administered preliminary to an inhalation anesthetic, will decrease and often abolish the stage of excitation. The preoperative use of morphin sulphate, when given in repeated dosage until physiological effect has been produced, will blunt sensibilities, quiet apprehension and lessen preoperative anxiety, as well as exercise control in metabolic processes. Under heavy dosage there will be no special change in the cells of the brain, suprarenals and liver, no increased out-put of adrenalin by reason of the fact that there will be conservation and not an expenditure of energy.[3]

Ether is absorbed through the lungs with very great rapidity, less quickly through the mucous membrane of the gastro-intestinal tract, and is eliminated by the lungs and kidneys. Its first action upon the circulation is the raising of arterial pressure by increasing the output of work from the heart. Vasomotor centers are stimulated and contraction of blood vessels follow. Large doses depress both heart and vasomotor systems. Full doses act as a depressant to the ganglionic cells or to the nerve centers, paralyzing the cerebral cortex from which loss of consciousness occurs. The activity of the spinal cord is lessened with resultant loss of sensibility, complete muscular relaxation and paralysis of reflexes.[4] Rarely the loss of sensibility precedes the loss of consciousness.

The ether used by instillation is taken up by the blood vessels surrounding the colon carried to the

heart and finds its journey's end in the lungs, where it is moistened and warmed to the body temperature. The exhalation of this vapor may be utilized and its rebreathing will prolong its useful action. It is well to remember that ether anesthesia alone offers no protection to the cells of the brain as a reparative measure of preanesthetic expenditure of energy or exhaustion from surgical trauma.

Paraldehyde, in the frog and in mammals, produces sleep. It is accompanied by complete muscular relaxation and loss of sensibility. The heart is not affected until late, death resulting from paralysis of the respiratory centers. The cells of the brain and the lower nervous system are influenced by the toxic dose, functional activity of the spinal cord, both its motor and sensory nerve trunk, is decreased, muscular action is restricted. Elimination is accomplished by the urine to which it imparts its odor. Paraldehyde is useful, as an hypnotic and may be used in combination with more powerful drugs in serious forms of morbid wakefulness not dependent upon pain.[5] When combined with magnesium sulphate and morphin sulphate, there is a prompt induction of mental quietude and rest, while the central nervous system becomes more receptive to the addition of ether, which forms one of the ingredients in the analgesic combination. Without the addition of paraldehyde, there does not appear so great a cooperative action upon the spinal cord in the final production of muscular relaxation.

To counteract the preoperative physical and mental manifestations, the immediate effects of the general anesthetic and the surgical trauma, every possible safe-guard should be grouped about the patient, with as much care as one would discriminate in the operative measure of choice, employing the most efficient means to produce an absence of sensibility to pain, with cessation of fear and anxiety, that may be accomplished by general or local anesthesia or analgesia with anesthesia.

When magnesium sulphate, morphin sulphate and ether are combined and used as a base, there may be added chlorotone, cannabis indica, paraldehyde, deodorized tincture of opium and in favorable cases the H. M. C. tablets of the Abbott Laboratories. These combinations will result in analgesia with or without loss of consciousness. Magnesium sulphate may be used alone or in conjunction with morphin sulphate, this combination being best given by hypodermoclysis. Analgesia is not present until ether is added after which the mixture is best given by the rectum; if magnesium sulphate is omitted, ether and morphin sulphate being left, water used in its place, analgesia will not be present.

Paraldehyde when made a part of the analgesic combination, will prevent an exhibition of what might be termed a mild second anesthetic stage. It has often been noted after the giving of an analgesic mixture without paraldehyde, that there will follow a continued uneasiness, low muttering speech and reflex muscular movements; a mild degree of analgesia will be present as a result of the previously described combinations but the addition of paraldehyde to the mixture is readily apparent by its effects in causing the patient to pass gradually into a quiet drowsy condition, which if left alone, will be continuous until the entire effect of the analgesic has passed away. The omission of paraldehyde is also noted in the postoperative stage, when the patient has been returned to bed, for uneasiness and emotional changes will appear.

OTHER SYNERGISTS.

Chlorotone is best given by mouth or in rectal suppositories, when given alone, in doses gr. v to gr. x, there is no appreciable increase in the analgesia, although sleep is deeper and the patients more often unconscious and sleeping. Chlorotone and morphin sulphate when used in the preoperative stage, may cause the patient to pass from the first stage of anesthesia, directly into the surgical degree. There may be no stage of excitation. The following is a very good technic and one often used:—Chlorotone gr. x given one hour before operation; morphin sulphate gr. ⅛ or ¼, plus atropin sulphate gr. 1/150 fifteen minutes later; morphin sulphate gr. ⅛ fifteen minutes later. There will follow a most excellent result in lessening the effects of surgical trauma and instrumental irritation. Chlorotone can be used alone by mouth, previously to the giving of the magnesium-morphin sulphate solution, in dosage of gr. v to gr. xv. It is also given by mouth in combination with fluid extract cannabis indica, in dosage, chlorotone gr. v-gr. xv and fluid extract cannabis indica gr. v to xv.

Cannabis indica in combination has a selective action similar to paraldehyde but because of the difficulty of obtaining an efficient product, it was not used in the routine combination.

Chlorotone and fluid extract cannabis indica were used in combination, in the form of rectal suppositories and given between the magnesium-morphin sulphate solution, and the sigmoid instillation of ether-paraldehyde and olive oil. It was noted that their use resulted in deep analgesia, lessened mus-

cular rigidity and the length of time for the continued use of the inhalation was shortened.

The deodorized tincture of opium is a very poor substitute for morphin sulphate, in that postoperative pain is more frequent and analgesia less profound; nausea more constant and rigidity of abdominal walls more pronounced.

The analgesic action of these different combinations in many cases was most excellent and often exceeded the more simplified routine method now in use, but they have been in most instances abandoned because of the great amount of work required in their exact and perfected technic and when many operations are to be performed in continued sequence, I found it almost impossible and at many times unreasonable to interfere with the routine program of the hospital.

HYPODERMOCLYSIS AND SIGMOID INSTILLATION.

Two avenues of administration are available, one by hypodermoclysis beneath one or both breasts and the other by sigmoid instillation. It is often deemed advisable to use the hypodermoclysis in the buttocks or between the shoulder blades or inner surface of thighs or both avenues may be used in the one subject. In employing the first method some degree of care must be exercised and the usual surgical principles of asepsis observed. Also the penetrating needle must not enter a vein and this occurrence may be readily recognized by the return of blood through the needle before connecting the syringe or carrying tube. It is most important that nothing but a pure, clean and specially purified grade of magnesium sulphate be used. It must be freed not only from all mechanical dirt but also from chemical impurities; 20 to 30 c.c. of a chemically pure 25 per cent. solution of magnesium sulphate, made with distilled water, filtered and sterilized, may be slowly injected beneath one breast or equally divided and injected into both breasts; or the 20 to 30 c.c. magnesium sulphate may be diluted with four ounces of distilled and sterilized water and injected equally in both breasts.

Greenough, at the Presbyterian Hospital in New York City, finds it advantageous to use magnesium sulphate in four per cent. solution, giving 200 to 400 c.c. by hypodermoclysis, one and one-half hours before the operation, the solution running in by gravity; in not less than thirty minutes, this is followed by hypodermic of morphin gr. ⅛ at fifteen or twenty minute intervals until ⅜ grain has been administered.[6]

Walter Lathrop, of the State Hospital, Hazelton, Pa., has used very successfully in goitre and tonsil work, 25 minims of 25 per cent. magnesium sulphate solution plus morphin sulphate gr. ⅛ at 15 minute intervals for three doses followed by sigmoid instillation of ether 1½ to 2 ounces, plus paralydehyde one dram and olive oil four ounces.[7]

In abdominal and pelvic work, I have found it necessary to continue more consistently with the analgesic chain. The simple use of magnesium sulphate, morphin sulphate and ether in combination is not sufficient to produce deep analgesia, whereby abdominal sections may be performed, and even with the addition of paraldehyde, *per rectum,* in one dram doses, the technic often fails in relieving the muscular spasm or rigidity of the abdominal parietes. Chlorotone and cannabis indica given by mouth or in suppositories followed by magnesium sulphate and morphin sulphate beneath the breast or breasts, to be followed by sigmoid instillation of ether, paraldehyde and olive oil, or glucose and olive oil, will give most excellent results.

METHOD OF USE.

The inhalation anesthetic is required to make the skin incision, division of fascia and peritoneum. The inhalation may then be omitted for the entire operation, again it may be necessary to use it intermittently during part of the time occupied by operative procedure to be discontinued when automatic respiration has begun.

After working with many combinations in the analgesic chain and attempting to construct a simple and still an efficient technic, which can be used with safety in the ordinary run of hospital cases, it is my purpose to submit for your consideration the following procedure:—

The preliminary preparation in all cases is the same. The night before the operation, two soapsuds cleansing colonic enemas into the sigmoid are given, one hour apart, *i.e.* at 8 P. M. and 9 P. M., the rectal tube being inserted into the bowel ten to twelve inches. The morning of operation the patient is given two very slow, clear water enemas, one hour apart, *i.e.* at 5 A. M. and 6 A. M., the patient going to the toilet after each enema. Nothing is given to eat or drink after the supper of the night previous to operation. Two and one-half hours before the patient is taken to the operating room, an hypodermic of morphin sulphate gr. ¼ and atropin gr. 1/150 is administered. Fifteen minutes before the giving of the instillation, a rectal tube is inserted, sixteen to eighteen inches, for the purpose of carrying away any fluid that may have collected or flatus that may be present. The patient is then placed upon the ward carriage and two hours before the time speci-

fied for operation, is placed upon the left side with buttocks elevated and lower extremities well flexed. The instillation is then thrown very slowly into the sigmoid bowel, the time required being about fifteen minutes, the tube is clamped and left *in situ,* to be removed only when the patient is placed upon the operating table.[8]

After the giving of the sigmoid instillation the patient, if in the ward, is removed to an adjacent room which is previously darkened; if in a private room, the shades are drawn and door closed. Light is excluded from the eyes by covering the face with dark colored mask, and the ears stuffed with cotton. Occasional attention is given to the patient until removed to the operation room. As much noise as possible is avoided at all times. Orders and necessary conversation are given in low tones. There may be some nausea but seldom is vomitus present. Before being taken to the operation room, the patient is catheterized. In most instances the loss of sensation begins at the feet and extends upward, the patient reporting that the limbs feel heavy, and while they can move them they do not feel the pressure of mattress or bed clothes. Analgesia will increase until the patient will not feel the prick of a pin or the pinching of the skin.

FORMULA.

2 drams Magnesium Sulphate (C. P.)	8. gm.
1½ ounces Glucose (pure) *Merck*	45. gm.
1 ounce Olive Oil	30. mils.
5½ drams Acacia (granulated)	22. gm.
2 ounces Ether	60. mils.
4 drams Paraldehyde	15. mils.
¼ grain Morphin Sulphate	.016 gm.
12 ounces Water sufficient to make	360. mils.

Rub the acacia with the olive oil in a dry mortar until uniformly mixed. Dissolve the magnesium sulphate and glucose in 200 mils. of water, then add at once 30 mils. of this solution to the olive oil and acacia mixture contained in the mortar and triturate lightly and rapidly until a thick, homogeneous emulsion is produced. Add remainder of magnesium sulphate and glucose solution, in several portions, triturating after each addition. Transfer emulsion into a bottle of 500 mils. capacity and successively add the morphin sulphate previously dissolved in a small amount of water, the paraldehyde and the ether shaking well after each addition and lastly add sufficient water to make the product measure 360 mils. Close the bottle immediately with a well fitting cork, made secure with twine, and keep in a cool place.[9]

This formula may be changed by adding ether ½ ounce to the instillation mixture immediately before giving and I have often employed it in the large, robust or excitive patient. The patients, upon entering the operating room, are usually semi-comatose or sleeping, at times they may be more or less conscious and talkative; they can be moved from ward carriage to operating table, placed in Sims, Trendelburg or exaggerated lithotomy position without the slightest resistance or evidence of muscular rigidity. The usual operative drapings can be accomplished and the operation field prepared without disturbance.

In the instance of the patient showing signs of restlessness or evident lack of absorption, with the skin of the abdomen sensitive to the pin prick or scalpel point and abdominal walls rigid, I have used another hypodermic of morphin sulphate gr. ⅛. The inhalation anesthetic acts as an aid and combines general anesthesia with analgesia. At no time has there been the usual stage of excitation, so constant with general anesthesia only. When nitrous oxid-oxygen is used, after the method of Gwathmey, the greatest extent of success can be obtained and the patient will be returned to the normal almost immediately with the completion of the operation and return to bed.

The use of ether as an inhalation is best given by the closed drop method using the Flagg or Bennett inhaler. From one-half ounce to one and one-half or two ounces will be sufficient for an abdominal operation lasting forty minutes to one hour. All inhalation should be discontinued immediately upon muscular relaxation and loss of reflex sensation as upon continuance the patient will be plunged deeply into the danger zone.

CLINICAL RESULTS.

The intrinsic value of the various combinations of drugs that will bring about an analgesic states is of interest because of the clinical results that have been obtained. It is also important to recognize the fact that analgesia gives to the body that protection which the driving force must have to balance the expenditure of energy and the necessary preservation of its reserve vitality. Analgesia is but a development of the ether-oil colonic anesthesia to which the synergists have been added.

My records in over two hundred cases, show that the preoperative emotional factors do not appear, as the patient is convinced that the disagreeable effects and after-effects of the inhalation anesthetic will not occur. The fear, dread and anxiety of the operation room is not present, as the patient does not know when he is to be taken from his bed. The exhaustive effect of surgical trauma is almost completely

abolished, an analgesia begins one hour previous to operative measures, and continues for one-half to one hour following the return to bed.

Vomitus is seldom seen following return to consciousness, when cracked ice is given with no ill effects. The return to bed is followed by quiet, restful sleep, interrupted only by individual desires, or obedience to instructions.

The changes in pulse, respiration and blood pressure, in their respective phases are most constant in proportional difference. In 14 cases the pulse rate at end of operation was lower than at the beginning. The lowest rate at the beginning was 66; at the end 60. The highest rate at the beginning was 140; at the end 126. The average rate at the beginning was 96; at the end 85. These cases included 4 vaginal and 10 abdomino-vaginal operations, one of which was an abdominal hysterectomy with a pulse rate at the beginning of 108; at the end 100. In 150 cases three gave no change and 147 cases a variation from 2 to 20 beats.

In the respiratory phase 32 cases gave no change and 118 cases a variation of 2 to 10.

The blood pressure was taken in 70 cases:—

Beginning of operation (recumbent)	systolic lowest 100, highest 216	
	diastolic lowest 40, highest 130	
End of operation (recumbent)	systolic lowest 90, highest 140	
	diastolic lowest 40, highest 100	

At no time was there a drop in systolic pressure beyond fifteen points, while the average was 10+ mm.

The most conspicuous result in using synergistic analgesia, with and without inhalation anesthesia, is the total absence of shock or exhaustion. In a wide range in abdominal, pelvic and plastic surgery there has been no untoward incident chargeable to the synergistic combinations. The results I have obtained mark the beginning of an investigation, which will require much study and trial to perfect. There is no doubt that concomitant conditions and correlative circumstances will influence the combinations of choice in meeting the many pathological states. In some instances one technic appeared to be successful, while again a series of cases would present themselves which would show better results by making some material change in the analgesic combinations. Temperament and individuality influence the results more than age, sex or nationality. Acute diseases respond more quickly and the analgesia is more profound than when used in cases of long standing. The more careful the technic, the more successful the results.

The surgeon, with his fixed attention upon the prospective operative procedures, is often neglectful of the safety of his patient, as dependent upon the class of anesthetic to be employed. In the end, he may court defeat by lack of consideration of individual temperament. The anesthetist, in the fancied proficiency of his routine, makes no change in consideration or betterment of his work. One is so apt to overlook the fact of sudden and oft repeated surprise by failure in vital functions because of inherent weakness, sickness or disease, undiscovered, weakened or limited resistance. It may be a fact that many anesthetic deaths are due, not to the drug, *per se,* or its mode of application, but the peculiarity of the individual in failing to respond to the requirements which have so completely exhausted the stored up energy in the body, or the failure of the driving force to maintain the vital balance.

681 BERGEN AVE.

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TOXIC BY-EFFECTS OF THE ATROPIN GROUP.*

RALPH M. WATERS, M.D.,
SIOUX CITY, IOWA.

The fact that atropin sulphate, scopolamin hydrobromide and hyoscin hydrobromide acquire toxic properties with age is not generally recognized by clinicians and drug manufacturers. In hospitals, in which one of these drugs is constantly used and, therefore, the supply frequently renewed, one does not see the toxic by-effects which will be mentioned later. The occasional user is the man who can cite cases of unusual results. Some element in aging seems to result in deterioration. Whether the cause is exposure to light, variations in temperature or merely the *wear and tear* of time, is outside the province of this paper. *It is sufficient to state that all three of these drugs undergo changes with age, resulting in various untoward clinical effects occasionally of alarming moment.*

Therefore, I deem the subject worthy of discussion to the end that drug manufacturers and chemists may be led to solve the problem of preventing

*Read during the Joint Meeting of the American Association of Anesthetists and the Mid-Western Association of Anesthetists, Hotel Jefferson, St. Louis, May 22-24, 1921.

deterioration, or, if this be impossible, that such products may be stamped with an expiration date, as, for example, are bacterins and serums. Some action is necessary to prevent accidents from the use of this very valuable group of drugs.

PERSONAL EXPERIENCES.

My opportunities for observation of the effect of these drugs have been varied. During the years 1910, 1911 and 1912 at Western Reserve University, Cleveland, Ohio, I saw scopolamin and hyoscin used routinely, without bad results; scopolamin in the surgical department as part of a preoperative hypodermic, and hyoscin in the obstetrical department at the end of the first stage of labor. In 1913 I came to Sioux City, Iowa. Atropin sulphate was here used frequently by the profession, while preparations of hyoscin and scopolamin were rarely used, either as preoperative sedatives or otherwise. Hyoscin and scopolamin were in disrepute with some men. Stories were told of *amnesia* lasting long periods, mental derangement and extreme respiratory and circulatory depression following the use of these two drugs.

Doubting the stories because of my previous experience, I used scopolamin both for preoperative hypodermic medication and in obstetrics, with no ill effects. Until 1916 my work was confined to one hospital (later referred to as Hospital No. 1) and the drug was not used there before my arrival, hence the preparations used were fresh. I was absent from the city in 1916 on the Mexican Border (U. S. A.). In the order of their occurrence the following experiences occurred after my return:

1. *Scopolamin Tablets.*—In 1917, in Hospital No. 1, I saw the first alarming ill effect from scopolamin hydrobromide, *namely* complete amnesia of 72 hours duration with imperfect memory for a period of six months following, in a healthy adult male, operated for rectal fistula. A 1/100 grain tablet of scopolamin was used with ¼ grain morphin as a preanesthetic sedative. An investigation of the hospital drug supply showed over forty different tubes of scopolamin of varying doses on the several floors, which had accumulated during my four years' contact with the institution, (1912-1916). A small stock of fresh drug in ampules has prevented further similar experiences in this hospital.

2. *Scopolamin in Ampules.*—An ampule of scopolamin, grain 1/200, purchased in 1915 and used in a preoperative hypodermic in 1919, caused twenty-four hours of extreme continual sneezing and dryness of the nasal mucosa. A second ampule administered without morphin to a nurse caused similar symptoms for twenty-four hours. These samples had been stored in the original package in the attic of my home for two of the four years while in my possession. My confidence being considerably weakened by these experiences, I have used little scopolamin and hyocin since, except when I was sure of the reliability of the stock supply.

3. *Atropin Sulphate Tablets.*—In 1921, 1/150 grain of atropin sulphate, used in Hospital No. 2, resulted in a severe delirium lasting some hours. This tablet was from a bottle of five hundred hypodermic tablets, a stock supply for a 25 bed ward, and the bottle was nearly empty. I have also seen two cases in which the respiratory rhythm was seriously disturbed by old preparations of atropin sulphate. For the past year I have been very particular to use only a known fresh supply of any member of the atropin group.

4. *Scopolamin Tablets Cause Loss of Memory.*—On March 15th, 1922, a preoperative hypodermic, containing scopolamin hydrobromide, grain 1/150, was ordered by a surgeon at Hospital No. 3. The patient was a farmer 30 years old, sick with acute mastoiditis. I had been particular to use only hyoscin hydrobromide here during the past year. A complete amnesia resulted which has not cleared up at the present time, although a report on May 20, 1922, indicates improvement. The patient does not remember events occurring after he entered the hospital. Memory of recent events is also gone; he fails to remember what he starts to do at his work. In conversation with his brother, he will decide to do certain work in the field and then will return without accomplishing the work, having forgotten what he intended doing. The tablet of scopolamin used in this case was the last in the bottle and only a bit of powder remains, but if there were another tablet in the vial I could not be induced to use it. I had not used scopolamin in this hospital for at least a year and the bottle contained only one tablet. It was certainly some years since it had left the manufacturer. The operative recovery has been ideal in this case and the possibility of brain complication has been eliminated.

In view of what I have here related it is not surprising that I no longer doubt the statements made to me regarding by-effects of scopolamin and hyoscin to which I took exception in 1913. From personal experience I have as much reason to fear old preparations of atropin as those of hyoscin and scopolamin. I am positive that when the drugs have not deteriorated their action is most useful.

SUMMARY.

1. Toxic by-effects have followed the use of scopolamin hydrobromide, hyoscin hydrobromide and atropin sulphate, which are sometimes of a serious and alarming nature.

2. The fact that the alarming effects here recorded followed the use of old preparations leads to the conclusion that these drugs deteriorate with age, producing unexpected clinical results.

3. The suggestion is here made that manufacturing pharmacists date the vials in which these drugs are marketed, for the clinician's guidance until such time as more definite knowledge may be had of the chemistry and pharmacology of the atropin group of drugs.

107 GILMAN TERRACE.

TOXIC EFFECTS OF LOCAL ANESTHETICS.

It will be recalled that on two previous occasions a Committee of the Eye, Ear, Nose and Throat Section of the American Medical Association has reported on the toxic effects of local anesthetics. This work of investigation is being continued by a Special Committee under the auspices of the Therapeutic Research Committee of the Council on Pharmacy and Chemistry.

In this connection the Editor of the Anesthesia Supplement is in receipt of the following letter, which speaks for itself, and he requests all those having pertinent information to furnish the same without reservation for the benefit of all concerned.

Dear Doctor:

This Committee has organized for the purpose of investigating the causes of numerous accidents which have followed the use of local anesthetics with a view to preventing these accidents so far as possible.

It is necessary to collect data for study and the undersigned has been appointed as the representative of the Section of the American Medical Association in which you are registered to secure the information needed.

The sole purpose of this investigation is to assist in increasing the safety, value, and importance of local anesthesia. All information received by the Committee will be considered strictly confidential.

Will you, therefore, kindly furnish the following information as promptly as possible, using the reverse side of this sheet?

1. Have you, during 1920 or 1921, observed any toxic effects—fatal or not—following the use of cocain or any of the other local anesthetics?

2. If you have observed such toxic effects please submit a detailed report of each case; record, among other facts, data concerning the patient's general condition, the occasion for using the local anesthetic, the drug employed, the method of administration and the dose administered.

3. Kindly inform the Committee of the name and address of any physician whom you know to have had any accident with any one of the local anesthetics.

Very truly yours,
HENRY S. DUNNING, M.D.,
33 East 68th Street,
New York, N. Y.

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

OCTOBER EDITORIALS 1922

MORE HONORS RICHLY DESERVED.

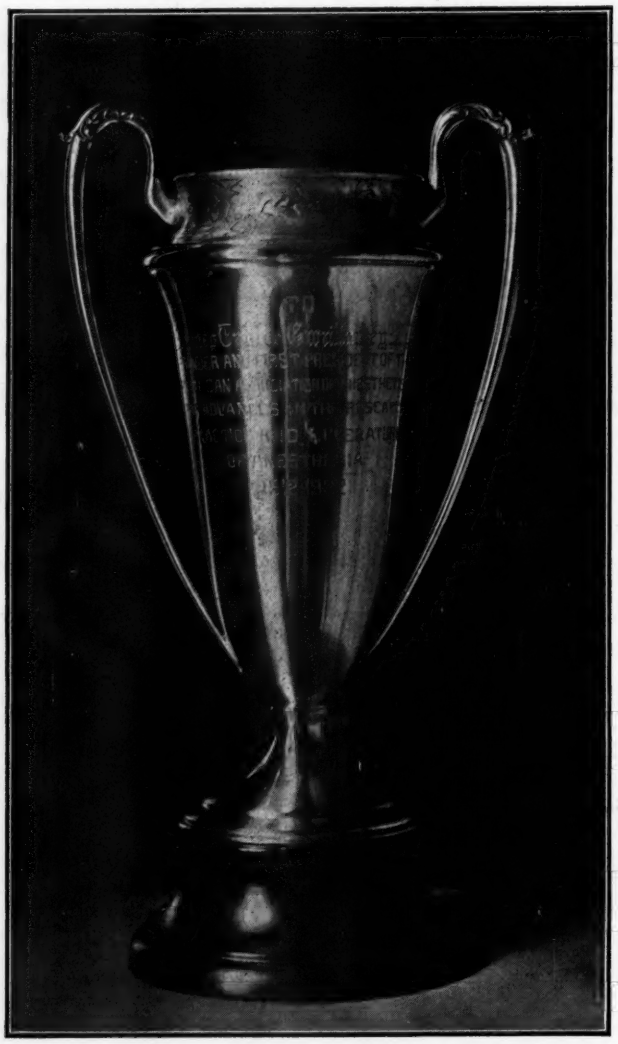
During the Tenth Anniversary Meeting of the American Association of Anesthetists in Joint Session with the Mid-Western Association of Anes-

Dr. James T. Gwathmey.

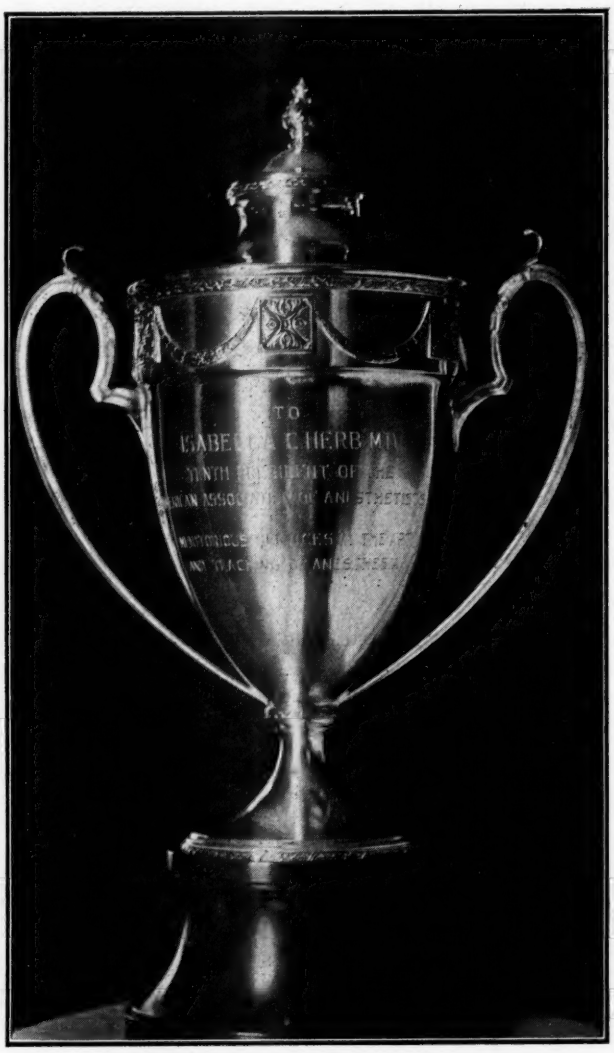
thetists, Dr. James T. Gwathmey was presented with a silver loving cup in recognition of the fact that he was the Founder and First President of the American Anesthetists. This cup was inscribed as follows:

TO

JAMES TAYLOE GWATHMEY, M.D.,
FOUNDER AND FIRST PRESIDENT OF THE
AMERICAN ASSOCIATION OF ANESTHETISTS
FOR ADVANCES IN THE RESEARCH, PRACTICE
AND LITERATURE OF ANESTHESIA.
1912—1922



Loving Cup Presented to Dr. Gwathmey.



Loving Cup Presented to Dr. Herb.

In 1912, Gwathmey, in association with anesthetists throughout the United States, as well as research workers from the Sections on Pharmacology and Therapeutics of the A. M. A., organized the American Association of Anesthetists at Atlantic City. A year later he was Presiding Officer at the first scientific meeting of the Association, at Minneapolis, during A. M. A. Week. Since that time the Association has continued its annual meetings with ever increasing success and its roster now includes almost all members of the profession devoting their time exclusively to the specialty of anesthesia.

Gwathmey, in collaboration with the late Prof. Baskerville, wrote the most comprehensive textbook on anesthesia now extant, and it is understood he is working on the *second edition* of this classical and monumental work. For years Gwathmey has devoted himself not only to basic and fundamental researches in anesthesia and analgesia, but has also invariably gone into the clinic and rendered them practical and useful. Among his more recent special contributions may be mentioned ether-oil colonic anesthesia and synergistic anesthesia and analgesia.

At the same meeting of the American and Mid-Western Anesthetists, Dr. Isabella C. Herb, was honored with a loving cup as the Presiding Officer of the Tenth Anniversary Meeting as well as for her personal achievements in the specialty. The loving cup presented to her was inscribed:

Dr. Isabella C. Herb.

TO
ISABELLA C. HERB, M.D.,
TENTH PRESIDENT OF THE
AMERICAN ASSOCIATION OF ANESTHETISTS
FOR MERITORIOUS SERVICES IN THE ART
AND TEACHING OF ANESTHESIA
1922

Isabella Herb is not only the Dean of the women physicians in the specialty, but she has been accorded the distinction of the Presidency of both the Interstate and American Associations of Anesthetists. She was associated with Prince in his development of drop ether anesthesia and for years her clinic at the Presbyterian Hospital, Chicago, has been a mecca for the art and teaching of anesthesia. She has accomplished a great deal in developing instruction of medical students and internes in anesthesia as well as introducing many aspirants into the specialty through postgraduate courses.

Perhaps the most touching event of the St. Louis Meeting was the presentation of a Memorial Tablet in honor of the late Dr. Jos. MacDonald, Jr., in behalf of the Associated Anesthetists of the United States and Canada. This bronze tablet was inscribed as follows:

Memorial Tablet to Dr. MacDonald.

1870 FOR SERVICES 1922
TO HIS COUNTRY, ANESTHESIA
AND MEDICAL JOURNALISM
THE ASSOCIATED
ANESTHETISTS
DEDICATE THIS TRIBUTE
TO THE MEMORY OF
DR. JOS. MACDONALD, JR.

This tablet has been sent to Mrs. Minnie MacDonald, to be permanently placed where it will, for all time to come, recall what Dr. MacDonald did for the specialty, and in so doing, for suffering humanity.

It is to be hoped that the splendid precedents, now established, for honoring those worthy of recognition, will be continued.—McM.

ALL PLANS FOR THE CONGRESS OF ANESTHETISTS AT COLUMBUS, OCTOBER 30 TO NOVEMBER 1, AND ALSO FOR THE ORGANIZATION MEETING OF THE SOUTHERN ASSOCIATION OF ANESTHETISTS, AT CHATTANOOGA, NOVEMBER 13-15, HAVE MATURED AND SPLENDID MEETINGS AND PROGRAMS ARE ASSURED. MAKE YOUR PLANS AT ONCE TO BE IN ATTENDANCE AT ONE OR BOTH OF THESE MEETINGS AS THEY WILL PUT YOU IN TOUCH WITH WHAT IS BEST AND NEWEST IN THE SPECIALTY OF YOUR CHOICE. FOR FURTHER INFORMATION ADDRESS THE EDITOR OF THE SUPPLEMENT.

Society Proceedings

ST. LOUIS MEETING OF THE AMERICAN AND MID-WESTERN ASSOCIATIONS OF ANESTHETISTS.

The American and Mid-Western Associations of Anesthetists met in joint session in St. Louis, May 22-24, 1922, at the Hotel Jefferson, the first three days of A. M. A. Week.

In opening the sessions Dr. R. M. Waters presented the gavel to the presiding officers, Dr. Isabella C. Herb and Dr. David E. Hoag, in behalf of the two Associations. Dr. Vilray P. Blair, of St. Louis, gave the Address of Welcome in behalf of the local profession.

During the preliminary executive session the minutes of the Boston and Kansas City meetings as well as the Treasurer's reports were accepted as read. The following new members were elected to the American Association of Anesthetists:—

Drs. G. C. Appelle, Champaign, Ills.; C. S. Baker, Evansville, Ind.; Geo. E. Beckman, Jacksonville, Fla.; W. L. Blomgren, Chicago, Ill.; A. R. Brandenburg, Milwaukee, Wis.; A. L. Connelly, Buffalo, N. Y.; H. J. Connor, Concord, N. H.; Gaston Day, Jacksonville, Fla.; J. DeBoer, Chicago, Ill.; O. F. Eckel, Asheville, N. C.; J. W. Flinn, Prescott, Ariz.; I. H. Goldman, Richmond, Va.; Julia H. Hardin, Philadelphia, Pa.; W. B. Harvey, Pittsburgh, Pa.; J. G. McConahy, Newcastle, Pa.; W. L. Owen, South Bend, Ind.; Stephen Palmer, Poughkeepsie, N. Y.; B. R. Reinertsen, Minneapolis, Minn.; J. S. Reitnauer, Jersey City, N. J.; F. T. Romberger, W. Lafayette, Ind.; S. D. Ruggles, Portsmouth, O.; R. L. Schaeffer, Allentown, Pa.; G. L. Spalding, Indianapolis, Ind.; C. A. Wells, Quincy, Ill.; Dorothy A. Wood, San Francisco, Cal.; E. U. Wood, Columbus, Ind.

The following members were elected to the Mid-Western Association of Anesthetists:—

Drs. C. J. Coffey, Chicago, Ill.; A. R. Sorbel, Sisseton, S. D.; A. J. McKechnie, Louisville, Ky.; O. F. Metcalf, Louisville, Ky.; Geo. E. Beckman, Jacksonville, Fla.; Ansel M. Caine, New Orleans, La.

During the scientific sessions the following papers were presented and discussed:—

Currents in the Progress of Anesthesia, (President's Address Mid-Western Association of Anesthetists). David E. Hoag, M.D., Pueblo, Col.

Anesthesia in Children, Safest Methods and Agents. Frances E. Haines, M.D., Chicago.

Toxic By-Effects of Hyoscin and Scopolamin. R. M. Waters, M.D., Sioux City, Ia.

Operative Shock, Glucose and Calcium Therapy. James V. Ricci, M.D. and Lillian K. H. Farrar, M.D., New York City.

Calcium Therapy in Relation to Operation and Results in Obstructive Jaundice. Waltman Walthers, M.D., Rochester, Minn.

The Preliminary Examinations of Patients Who are to Undergo Surgical Operations. Albert H. Miller, M.D., Providence, R. I.

A Review of Synergistic Anesthesia and Analgesia. James T. Gwathmey, M.D. and James Greenough, M.D., New York City.

During the Symposium on the Cardio-Respiratory Mechanism in Relation to Anesthesia and Oxygen Therapy, the following papers were presented and discussed:—

The Ill-Effects of Oxygen Insufficiency During Anesthesia. (By Proxy.) Eugene Cary, M.D., Chicago, Ill.

Preliminary Note on the Concentration of Nitrous Oxid and Oxygen in the Blood During Anesthesia. Charles W. Greene, Ph.D., Hiram M. Currey, and Frank E. Dexheimer, Columbia, Mo.

The Faults of Haste in Nitrous Oxid Induction. Arthur E. Guedel, M.D., Indianapolis, Ind.

Scope and Utility of Oxygen Therapy and Method of Administration. Alvan R. Barach, M.D., New York City.

Eleven Years' Observation of the Minute Volume of Respiration in Anesthesia with a Discussion of Some Factors Affecting Same. E. I. McKesson, M.D., Toledo, Ohio.

Oxygen in the Peritoneal Cavity. Wm. Seaman Bainbridge, M.D., New York City.

Suspended Respiration as a Test for Surgical and Anesthetic Risk. Gilbert FitzPatrick, M.D., Chicago.

The Special Address of Prof. Martin H. Fischer on "The Cause and Treatment of Coma Following Anesthesia and Operation," was masterly and held those in attendance spellbound.

During the Anesthesia Session of the American Medical Association Section on Miscellaneous Topics, the following papers were presented and discussed:—

Postoperative Lung Complications, (Chairman's Address). Isabella C. Herb, M.D., Chicago.

Relation of the Anesthetic to Pulmonary Abscess Following Nose and Throat Surgery. Cline N. Chipman, M.D., Washington, D. C.

An Experimental Study of the Epinephrin Content of the Adrenal land Under Anesthesia and in Shock. J. F. Corbett, M. D., Minneapolis.

Clinical and Experimental Studies on the Cerebro-Spinal Fluid Tension in Relation to Surgical and Anesthetic Risk. Harry Jackson, M.D., Chicago.

Synergistic Analgesia: Clinical Observations. J. M. Rector, M.D., Jersey City, N. J.

The Effects of the Repeated Administration of Anesthetics on Blood Catalase. W. E. Burge, Ph.D., Urbanan, Ill.

During the Joint Meeting with the St. Louis Dental Society the following papers were presented and discussed:—

The Relation of Diet to Dental Disease. Percy Howe, D.D.S., Boston.

Pathological Conditions Due to Focal Infections in Relation to Anesthesia, Especially Nitrous Oxid-Oxygen. C. A. Barnhill, D.D.S., Indianapolis, Ind.

Better Nitrous Oxid Anesthesia. George F. Seeman, D.D.S., Nashville.

Secondary Saturation for Oral Surgery and Difficult Extractions Under Nitrous Oxid-Oxygen Anesthesia. B. H. Harms, D.D.S., Omaha, Neb.

During the Symposium on Complicating Factors of Anesthesia the following papers were presented followed by a general discussion:—

Circulatory Changes Under Operation and Anesthesia. Morris H. Clark, M.D., Kansas City, Mo.

Circulatory Changes Under Anesthesia. John R. Worley, Dallas, Texas.

Some Unusual Anesthetic Experiences. Ansel M. Caine, M.D., New Orleans, La.

Case Reports of Complications Under Anesthesia. Edward H. Lane, M.D., East St. Louis, Ill.

Some Unusual Phenomena Following Anesthesia. J. E. H. Atkeisson, M.D., Chicago.

Status Lymphaticus as a Factor in Nose and Throat Surgery. E. Lee Myers, M.D., St. Louis.

In the final Executive Session of the several Associations the following Officers were elected for the 1923 meetings:

American Association of Anesthetists—Eleanor Seymour, M.D., Los Angeles, President; F. L. Richardson, M.D., Boston and Samuel Johnston, M.D., Toronto, Vice-Presidents; F. H. McMechan, M.D., Avon Lake, Ohio, Secretary-Treasurer; Thomas J. Collier, M.D., Atlanta and Charles E. Eha, M.D., Cincinnati, Executive Committee.

Mid-Western Association of Anesthetists—B. H. Harms, D.D.S., Omaha, President; R. S. Adams, M.D., San Antonio and Frances E. Haines, M.D., Chicago, Vice-Presidents; Morris H. Clark, M.D., Kansas City, Secretary-Treasurer; Floyd T. Bolend, M.D., Oklahoma City, C. A. Barnhill, D.D.S., Indianapolis, H. A. Elmquist, D.D.S., Des Moines, Myra E. Babcock, M.D., Detroit, T. L. Higginbotham, M.D., Wichita, and Edward H. Lane, M.D., East St. Louis, Executive Committee.

The Committee on Resolutions, Dr. Eleanor Seymour, Chairman, Drs. Arthur E. Guedel, C. C. McLean, Ansel M. Caine, and J. DeBoer, brought in the following resolutions which were discussed and adopted:—

RESOLVED, That the American and Mid-Western Associations of Anesthetists hereby express their appreciation to the Officers of the American Medical Association and the Council on Scientific Assembly for again according an Anesthesia Session in the Section on Miscellaneous Topics,

and pledge their continued activities in the advancement of the Specialty of Anesthesia.

II

RESOLVED, That the American Association of Anesthetists accept the invitation extended by the Pacific Coast Association of Anesthetists to hold a Joint Meeting in San Francisco the first three days of A. M. A. Week, in 1923.

III

RESOLVED, That Insurance Companies, both Indemnity and Fraternal, Workmen's Compensation Commissions and other Public Corporations, be required to pay anesthetic fees not less than the minimum charge allowed by the local fee schedule.

IV

RESOLVED, That the American and Mid-Western Associations of Anesthetists condemn the tendency in the various specialties to flat rate charges, salaries and fee splitting with hospitals, and urge their abolition; and further request their members to discontinue cooperations in such practices.

V

RESOLVED, That the American and Mid-Western Associations of Anesthetists unequivocally condemn the employment by physicians and hospitals of nurse and other lay-anesthetists, and that they further condemn the practice of commercializing the anesthetist to the financial benefit of the employer.

VI

WHEREAS, The protection of the patient, the advancement of surgery, and the development of hospital service, demand the administration of anesthetics by qualified physicians, therefore be it

RESOLVED, That the American and Mid-Western Associations of Anesthetists urge the American College of Surgeons, through its members and hospital standardization to eliminate the nurse technician and to confine the administration of anesthetics exclusively to qualified physicians.

VII

WHEREAS, It is public knowledge that the American Association of Anesthetists and all other regional organizations of anesthetists, have passed resolutions condemning lay anesthesia, and

WHEREAS, Failure on the part of members to uphold this standard, hampers the activity of and casts discredit upon these organizations, and

WHEREAS, A resolution was introduced and passed at the 1921 meeting in Boston to the effect that any member of the American Association of Anesthetists guilty of instructing nurses with a view to their becoming anesthetists should be deprived of membership, pending a cessation of this practice, and

WHEREAS, A year's grace was at that time granted such offenders, therefore be it

RESOLVED, That the original resolution now go into effect and the Secretary be instructed to take action accordingly.

VIII

WHEREAS, Legal opinions have been handed down by the State Attorneys and Counsels for various State Medical Associations, to the effect that it is unlawful for any one other than a regularly licensed physician or dentists to administer an anesthetic, except in emergency, or under the direct and continuous supervision of a physician—which in turn has been legally interpreted as meaning the undivided attention of said supervising physician, and

WHEREAS, It is common knowledge that many surgeons, including prominent members and officers of the American College of Surgeons and their recognized hospitals, are using nurses and other lay persons as anesthetists, thus infringing not only upon the practice of medicine but on an important specialty thereof, and

WHEREAS, Not only anesthesia, but professional standards in general, are greatly lowered as a result of such practices, anesthesia receiving but slight attention in the curricula of colleges and teaching hospitals, and being thus derated both as a medical specialty and as essential knowledge for the general practitioner, which inevitably results in (a) poor service to the surgeon and (b) increased anesthesia risk to the general public, and

WHEREAS, In most instances this is admittedly done for economic exploitation, these surgeons and hospitals employing lay anesthetists at a stipulated salary and pocketing their fees, and

WHEREAS, Wherever this work is being rated on the basis of a nurse's salary, it enables surgeons and hospitals to retain medical anesthetists at a similarly low salary, resulting in a large margin of profit to the employers, and

WHEREAS, Lay anesthetists may be allowed to collect their own fees, but are required to re-imburse their surgeons by office service, or when working on salary are allowed a percentage of fees for anesthetics administered after hours, and

WHEREAS, Physician anesthetists are debarred from certain hospitals, while in others patients are required to pay anesthetic fees to the hospital, although said patients retain and pay their private medical anesthetists, and

WHEREAS, The Fellowship Pledge of the American College of Surgeons reads as follows: "In particular I pledge myself to regard scrupulously the interests of my professional brother, to shun dishonest money seeking and commercialism, and secret money trades," therefore be it

RESOLVED, That the attention of the officials of the American College of Surgeons be called to the above facts, which they, as avowed custodians of our Medical Ethics, may well find within their province to remedy.

As a token of appreciation of services rendered during the year Dr. F. H. McMechan, Secretary-General of the Associated Anesthetists was given an appropriation from the funds of the several Associations as well as a private purse subscribed to by many of the anesthetists personally.

The meeting then adjourned subject to the call for the San Francisco meeting, June 25-27, 1923, for the American Association of Anesthetists, while the date of the Mid-Western Association of Anesthetists' meeting was left to the discretion of the Officers and Executive Committee.

FIRST MEETING OF THE SECTION ON ANESTHESIOLOGY OF THE MEDICAL SOCIETY OF THE STATE OF CALIFORNIA AND THE PACIFIC COAST ASSOCIATION OF ANESTHETISTS.

Dr. Mary E. Botsford, of San Francisco, Chairman of the Section on Anesthesiology of the California State Medical Society, called the Section to order for its first meeting at 8:15 p. m. in the Sentinel Hotel, Yosemite, May 15, 1922, and told of the creation of the Section by vote of the House of Delegates in session at Coronado, May 12, 1921, and the appointment of Dr. Mary E. Botsford as Chairman and Dr. Eleanor Seymour as Secretary, by the Secretary of the California State Medical Society.

Dr. Botsford then introduced Dr. F. H. McMechan, of Avon Lake, Ohio, General Secretary of the Associated Anesthetists of the United States and Canada, who extended the greetings of the other Anesthesia Societies and expressed his appreciation of the hospitality shown Mrs. McMechan and himself during their stay on the Pacific Coast.

The following nominations were submitted for Section Officers for the 1923 meeting: Dr. Edgar I. Leavitt, Chairman, and Dr. Lorruli A. Rethwilm, Secretary, both of San Francisco. They were elected by unanimous vote of the Section.

The Chairman, in behalf of the Executive Officers, presented the following resolutions:—

I

RESOLVED, That the Section on Anesthesiology of the California State Medical Society hereby expresses its appreciation to the House of Delegates for its creation, and hopes through its activities in the future to extend the advancement of the specialty in every way.

II

WHEREAS, The protection and safety of human life is a paramount issue in the practice of medicine, therefore be it

RESOLVED, That the Section on Anesthesiology endorses the action of the Section on Radiology in eliminating the technician from this vital phase of medical practice, and further be it

RESOLVED, That the Section on Anesthesiology approves and urges the continued activity of the California State Medical Society in eliminating the lay technician (nurses) from the practice of anesthesia.

These resolutions were passed without a dissenting vote.

The following Scientific Program was then presented:—

Post-Tonsillectomy Pulmonary Abscess, (President's Address). Mary E. Botsford, M.D., San Francisco.

The Relation of Surgeon and Anesthetist. Saxton T. Pope, M.D., President San Francisco County Medical Society.

Organization of the Hospital Department of Anesthesia. Caroline B. Palmer, M.D., San Francisco.

Analysis of Anesthesias in 80 Consecutive Brain Operations at The University of California Hospital. Dorothy Wood, M.D., San Francisco.

The Clinical Use of Oxygen. Lorruli A. Rethwilm, M.D., San Francisco.

Dr. George P. Waller, President, called the meeting of the Pacific Coast Association of Anesthetists to order for the first Scientific Program, at 2:30 on the afternoon of May 16, 1922, in the Assembly room of the Hotel Sentinel, Yosemite.

After preliminary announcements by the Chair concerning transportation and entertainment, Dr. F. H. McMechan, Honorary Secretary, was happily introduced as the guest of the Association and expressed his pleasure at being present and commended the progress made by the organization in so short a time. In token of appreciation, and as a memento from Mrs. McMechan and himself, he presented to Dr. Eleanor Seymour, Organization Secretary, a silver mounted gavel for the Association, to be engraved with the names of the presiding officers. Dr. Seymour in turn presented the gavel to Dr. Waller. After acknowledging this gift the following program was presented:—

Spasticity from Inflammation in Relation to Anesthesia. (President's Address.) George P. Waller, M.D., Los Angeles.

Anesthesia and Its Relation to the Patient, From the Surgeon's Standpoint; Type of Anesthesia in Relation to Existing Pathology; Emoluments to the Anesthetist. Harlan Shoemaker, M.D., Secretary Los Angeles County Medical Society.

Sacral Anesthesia—A New Method of Administration, with Report of Use in 400 Urological and Gynecological Cases. Albert J. Scholl, Jr., M.D., Mayo Clinic, Rochester, Minn.

Suggestive Leads in Anesthesia. F. H. McMechan, M.D., Avon Lake, Ohio.

Time as an Element of Safety in Anesthesia in Children, (By title). Mary T. Murphry, M.D., San Francisco.

The Heart in Surgery, (By title). E. E. Fisher, M.D., Salem, Oregon.

During the Executive Session a charter roll of sixty names was read, and all having been duly passed upon by the Executive Board were unanimously elected to membership. The minutes of the Organization Meeting at Coronado were accepted as read.

In behalf of the Executive Board the following resolutions were presented by the Secretary and each adopted in turn:—

I

RESOLVED, That the Pacific Coast Association of Anesthetists hereby extends its hearty appreciation of the splendid efforts of the State Board of Medical Examiners, The League for the Conservation of Public Health, its officers and their legal advisors in interesting themselves in the protection of public health and welfare by limiting the administration of anesthetics to legally qualified physicians.

II

WHEREAS, The safety of those coming to operation under anesthesia is a paramount issue in public health work, therefore be it

RESOLVED, That the Pacific Coast Association of Anesthetists hereby urges the Health Department of San Francisco eliminate nursing anesthesia and the dangers attaching thereto, by introducing the administration of anesthetic by expert medical anesthetists in the San Francisco City and County Hospital, and providing adequate funds for such purpose.

III

WHEREAS, The protection of the patient, the advancement of surgery and the development of hospital service demand the administration of anesthetics by qualified physicians, therefore be it

RESOLVED, That the Pacific Coast Association of Anesthetists urges the American College of Surgeons, through its members and hospital standardization, to eliminate the nurse technician and to confine the administration of anesthetics exclusively to physicians.

Dr. McMechan was instructed to extend greetings to the Canadian Anesthetists, at Winnipeg, and to the Congress of Anesthetists at Columbus; Dr. Seymour was similarly instructed to extend greetings to the American and Mid-Western Anesthetists, at St. Louis; and Dr. Botsford was selected Official Representative to the Section on Anesthetics of the British Medical Association, at the Glasgow meeting.

After admiring inspection the specially designed and artistically executed seal for the Association was accepted and a rising vote of thanks extended Mrs. Neil C. Trew, wife of the incoming President of the Southern California Society of Anesthetists for her beautiful creation. The Motto for the seal suggested by Dr. McMechan—"Divinum est sedere dolorem" (It is God-like to relieve pain) was unanimously adopted.

Election of Officers then followed and the ticket as proposed by the Nominating Committee was unanimously endorsed as follows: George P. Waller, M.D., Los Angeles, President; Mary E. Botsford, M.D., San Francisco, Vice-President; Eleanor Seymour, M.D., Los Angeles, Secretary-Treasurer; Executive Committee 1924, Walter R. Crane, M.D., Los Angeles; David E. Hoag, M.D., Pueblo, Col.; 1925, M. J. Rand, M.D., Elko, Nevada, R. L. Charles, M.D., Denver, Col., Caroline B. Palmer, M.D., San Francisco, and Louise A. Oldenbourg, M.D., Oakland, Calif.

During the second Scientific Session the following program was presented:—

Ethyl Chlorid as a General Anesthetic. Louise A. Oldenbourg, M.D., Oakland.

Physiological Effects of Nitrous Oxid. Neil C. Trew, M.D., Los Angeles.

Symposium on Intratracheal Anesthesia. Mary Kavanagh, M.D., and Edith Williams, M.D., San Francisco.

Anesthol, a Useful Anesthetic Mixture, (By Title). Louis H. Maxson, M.D., Seattle, Wash.

Nitrous Oxid Anesthesia in Infants, (By Title). Mary E. Botsford, M.D., San Francisco.

At the close of the program Dr. McMechan exhibited photos of the cups to be presented to Drs. James T. Gwathmey and Isabella C. Herb for distinguished services in the specialty of anesthesia. Dr. McMechan also extended congratulations on the success of the initial Pacific Coast meeting and pledged the cooperation of all the regional organizations.

Dr. Botsford then moved a vote of sincere thanks for the inspirational visit of the General Secretary and for his work in behalf of the specialty and his editorship of the official publications.

It was moved, seconded and carried that a cordial invitation be extended to the American Anesthetists, and the Section on Anesthetics of the A. M. A. to hold a Joint Meeting with the Pacific Coast Anesthetists in San Francisco June 25-27, 1923, the first three days of A. M. A. Week.

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